Electrical Industry Facts

Selected Statistics Point to Basic Business Trends

Price of Energy Has Decreased 18.5 per Cent Since 1913

FROM the time when the electric light first became a commercial possibility the price of energy has moved steadily downward and the cost of lighting has decreased even more rapidly. Disregarding the earlier period and starting with the average for 1913 as a base, the average residential rate has decreased 18.5 per cent and continues to fall, according to data published in the Monthly Labor Review, Bureau of Labor Statistics, for August, 1930.

The change has been nearly as great in the past five years as it was in the preceding twelve, as is shown by these values of the decrease from the 1913 level:

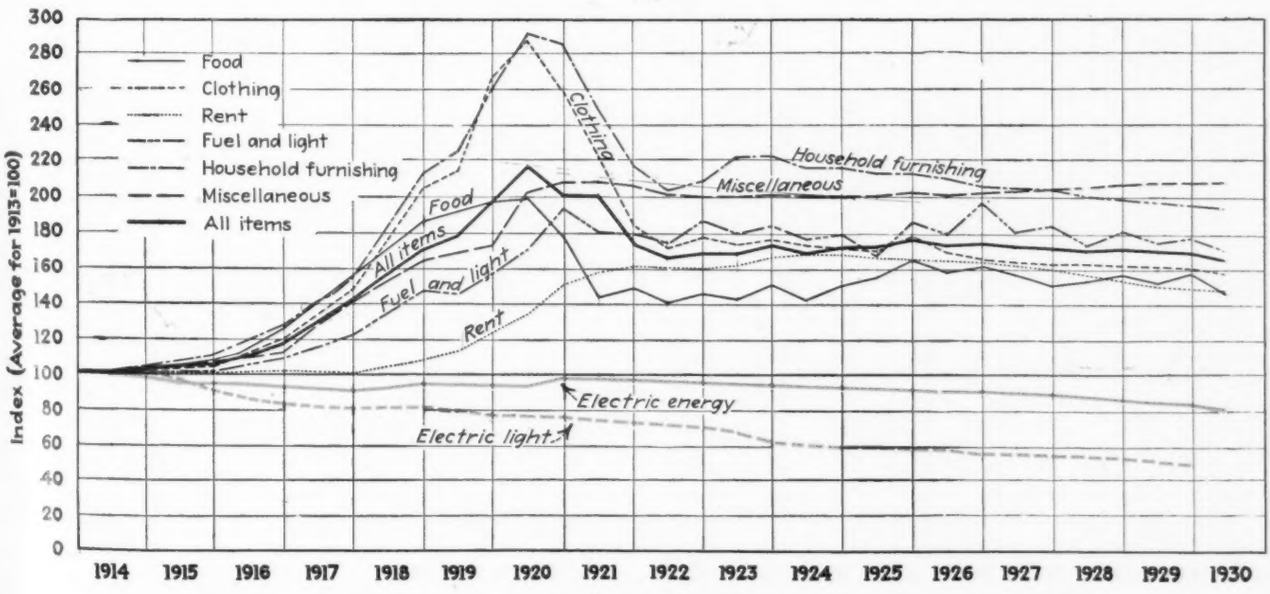
Date	Per Cent	Date	Per Cent
December, 1925	9.9	June, 1928	13.6
June, 1926	11.1	December, 1928	14.8
December, 1926	11.1	June, 1929	17.3
June, 1927	12.3	December, 1929	17.3
December, 1927	12.3	June, 1930	18.5

Meanwhile the cost of living as a whole, according to the same authority, stands 66.6 per cent higher than in the base year, after rising to a peak in 1920 that carried it more than 100 per cent above the starting point mentioned. Some of the essential commodities climbed much higher. The composite figure reached its present level, after passing the major peak, in 1922, but rose again to a minor peak in 1925, since which time the movement has been generally downward.

These data are all taken from the same official publication and are, therefore, strictly comparable. At the end of June, 1930, the index numbers for the various commodities stood as follows:

Food	147.9	Housefurnishing goods	195.7
Clothing	158.9	Miscellaneous	208.5
Rent	149.6	All items	166.6
Fuel and light	172.8	Electrical energy	81.5

The cost of light has decreased much more rapidly than the cost of electrical energy because of the improvements that have been made in the lighting units. The curve for this item is taken from the report of the lamp committee of the National Electric Light Association dated May, 1930. It indicates that the cost of light to the householder is now less than half as great as it was in 1913.



Relatively, electricity costs half and light a third as much as in 1913

New England Industry Improves

AFTER a downward movement starting last November, interrupted only in January and February, terminating in July with a rate of activity more than 30 per cent under that of the preceding October, New England's industries in August recorded a gain for the first time in half a year. The rise in general industrial activity was 4.3 per cent compared with July, according to the monthly consumption of electrical energy by about 400 manufacturing plants in this section as reported to the ELECTRICAL WORLD.

Operations, as measured by this gage, are still 22.2 per cent lower than in the corresponding month last year, and 15.2 per cent lower than in 1928; nevertheless, the showing is better than in June and July, which fell below 1929 by 23.8 and 26.5 per cent respectively.

Most of the industrial groups either participated in the gain or suffered no further loss, but in the main the regional gain is due to improvement in two important industries. Textiles in July had fallen to an extraordinarily low level, with about 50 per cent of the activity reported in the spring of 1929. From this stage the industry rose 16.2 per cent in August. It is still 25 per cent below last year's level, and the average for the first eight months is down 14.6 per cent.

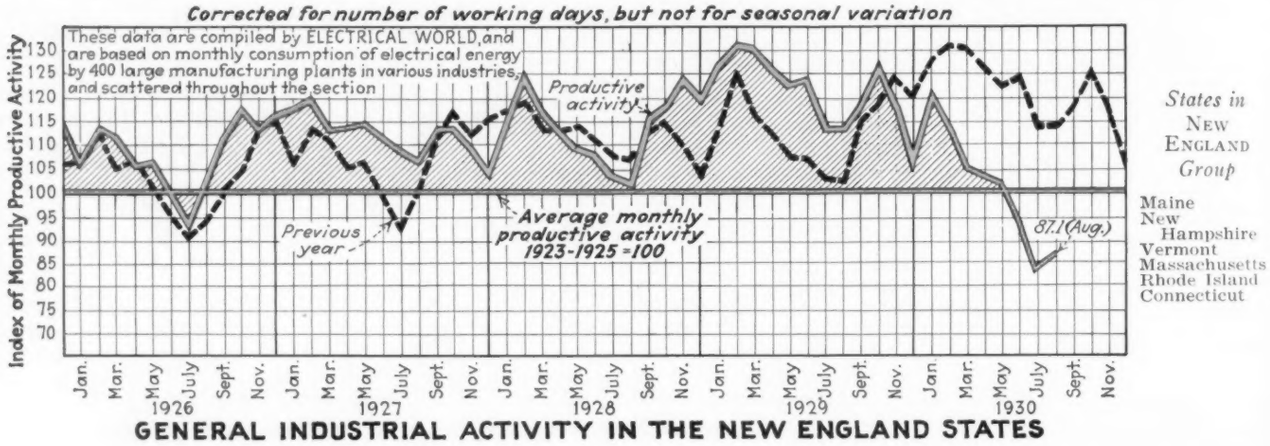
The other great industry, metal working, rose 4 per cent from the level of July, the low month, but remains 30 per cent lower than last year.

For the year thus far leather alone shows an appreciable gain (6 per cent) over 1929—not remarkable, considering the poor record of that year.

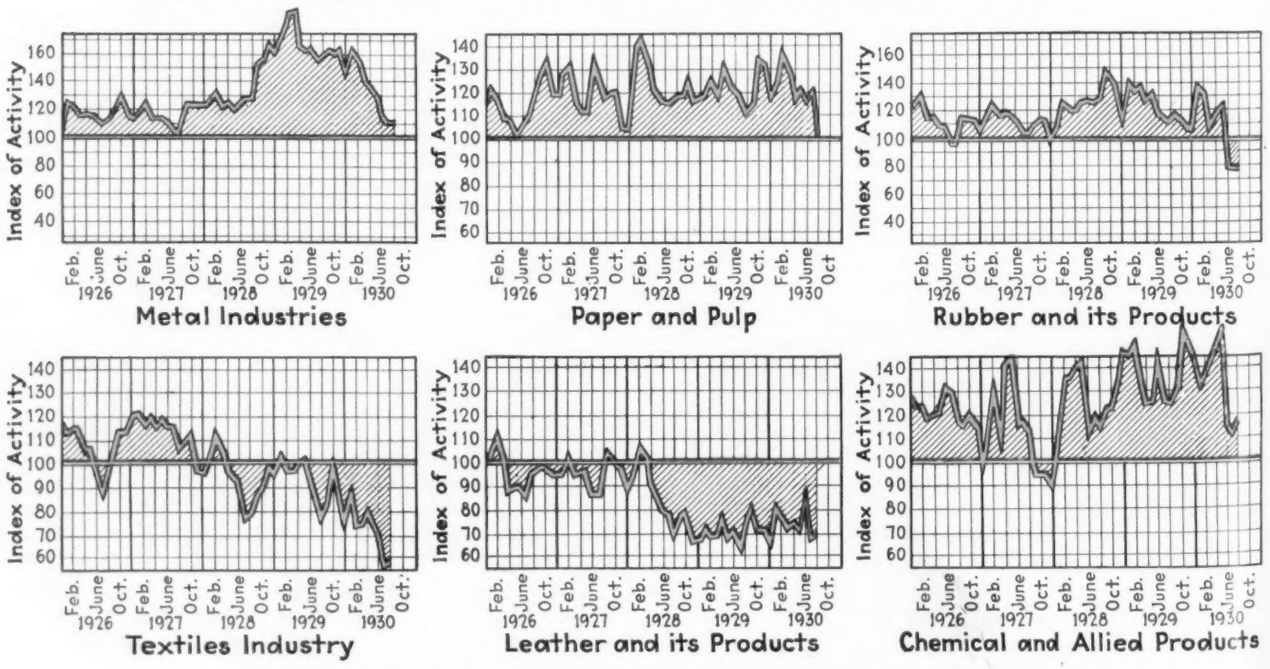
Current Manufacturing Activity Compared With That of Other Periods

New England States
(Per Cent Change)

	August, 1930, July, 1930	Compared with August, 1929	First 8 Months, 1930 and 1929
All industry	+ 4.3	—22.2	—18.1
Chemical products	+ 4.8	— 5.6	— 1.4
Leather products	+ 1.7	— 9.6	+ 6.0
Lumber products	0	—47.6	—42.0
Iron and steel	— 7.0	—30.3	—20.7
Metal-working plants	+ 4.0	—30.2	—23.4
Metals group (combined)	— 0.1	—30.2	—22.5
Paper and pulp	—15.0	— 5.6	+ 0.6
Rubber	+ 0.6	—27.8	—16.3
Textiles	+15.0	—25.0	—14.6



GENERAL INDUSTRIAL ACTIVITY IN THE NEW ENGLAND STATES



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Design and Construction Issue

The electrical industry grows. It becomes larger, more complicated—uses more and more equipment. New equipment and improved equipment is brought out each year. Engineering thought and practice change. Construction methods and devices are improved. In this ever-changing panorama it is necessary, but difficult, for electrical men to keep up to date. For the benefit of the industry the editors of *Electrical World* present in this issue samples of new ideas, methods and equipment used in design and construction. They are informative, and it is hoped they will be suggestive. The goal is to give more service and more value for the dollars invested in the industry

SEPTEMBER 27, 1930

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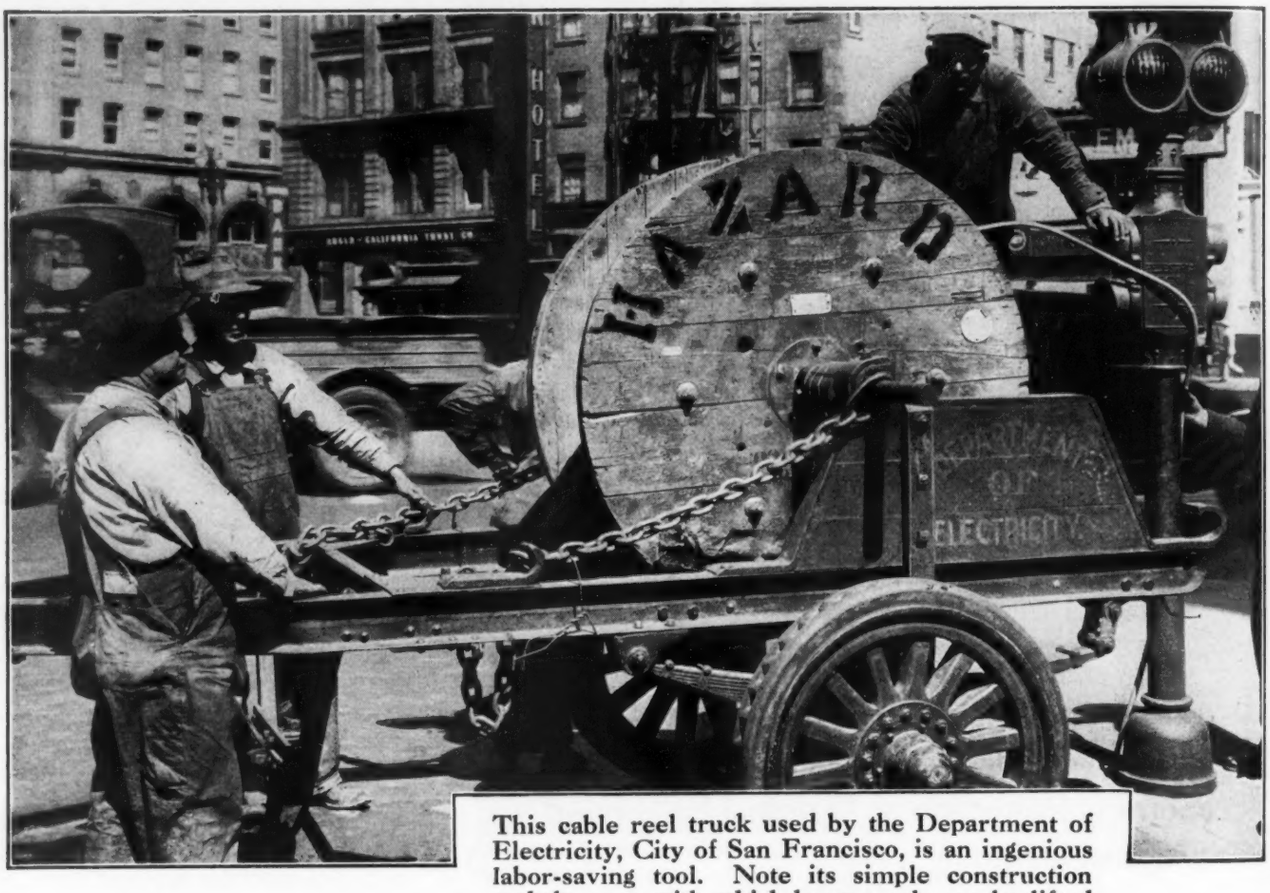
San Francisco Says a Good Word for Hazard



This cable reel truck used by the Department of Electricity, City of San Francisco, is an ingenious labor-saving tool. Note its simple construction and the ease with which heavy reels can be lifted and handled.

SEPARATE signal lights for pedestrians are part of the traffic control system now used in the congested centers of San Francisco. As increasing numbers of automobiles continue to complicate the traffic problem it is necessary to increase the control equipment and make it more dependable.

There are so many varying conditions among traffic signal installations that many types of signal cables are required adequately to meet every need. From among the complete lines of Hazard Municipal Signal Cables, San Francisco selected Hazard Lead Sheathed Cables for this underground installation, having had long and satisfactory experience with other Hazard Cables in the City's electrical work.

HAZARD INSULATED WIRE WORKS

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ELECTRICAL WORLD

for the Week Ending

September 27, 1930

Utility companies co-operate in drought to restore river navigation

Georgia Power fights uniform rates as unwarranted burden

Investors will force out utility facts, banker tells executives

—DESIGN AND CONSTRUCTION practices marshaled for annual review in ELECTRICAL WORLD. All fields of power generation and application show progress.

—GEORGIA POWER COMPANY fights proposal for uniform rates throughout state. President Arkwright, already burdened by $2,000,000 cut, views new $400,000 reduction askance.

—ST. LAWRENCE Power Commission appeals to power companies for their good will and co-operation. Names Jadwin, Woodward, Thurlow and Greene as an engineering board.

—OREGON Governor, concerned over scope of present laws, awaits decision of Attorney-General before calling contemplated special session of the Assembly for water-power emergency legislation.

—NAVIGATION MENACED on Monongahela River, West Penn Power Company arranges with Duquesne Light to supply needed energy and opens gates at Lake Lynn hydro plant to co-operate with government and restore flow.

—"UTILITIES which have something to conceal may as well set their houses in order," Empire State association is told; "the investor is the Nemesis of secrecy."

—UNIFICATION of steam and electric systems may bring economies, Chairman Maltbie of New York Commission concedes, but he detects no ensuing reductions in rates to the public.

—LIGHTNING PROTECTION of terminal equipment largely a matter of economics, utility engineer is convinced. If overall cost were to be disregarded, installations could now be made substantially lightning-proof.

NEWS OF THE WEEK

Central-Station Industry Shows Growth in 1930, Despite Hard Times

CONDITIONS in the electric light and power industry are very favorable and the outlook for an upward trend in output of electric power is excellent, declared Paul S. Clapp, managing director of the National Electric Light Association, in a report to the executive committee of the association, meeting at New York headquarters last week. Mr. Clapp said in part:

"Output of electric power for the nation as a whole in no week since the readjustment started has fallen more than 4 per cent below the corresponding weeks of the high levels of 1929. In most weeks these levels have been exceeded. Total sales of electric power to all classes of customers for the first seven months showed an increase of 1.4 per cent over 1929 and an increase of 14.4 per cent over the same period in 1928. Home use of electricity showed a large increase during the first seven months of the year over the corresponding period in 1929. Electricity sold to domestic customers showed a gain of 14.2 per cent over 1929 and of 30.4 per cent over the first seven months of 1928. Use of electricity by small light and power customers (such as stores, highway lighting, electric signs, small factories, etc.) showed an increase in the first seven months of 6.4 per cent over 1929 and of 23.2 per cent over 1928. Industrial use of power showed a slight decrease for the first seven months of 1930 under 1929. This decrease was 2.4 per cent, but the 1930 industrial use was still 9.9 per cent over the first seven months of 1928.

"The over-all industrial operations of the country, as reflected in electric power consumption indicated above, are maintaining levels only slightly under the record year of 1929. This is in part due to the shutdown by factories of their own power plants and the substitution therefor of purchased electric power.

"The total number of new domestic customers added to central-station lines in the twelve months, August 1, 1929, to July 31, 1930, is 730,107—this in spite of the fact that there has been a slowing down in residential construction and that the electrical industry is gradually approaching more nearly 100 per cent saturation in wired homes, particularly in urban territories. Farm electrification has shown an exceptional increase. In the first seven months of the year 70,000 additional farms were added to central-station lines—an increase of 13 per cent.

"The average domestic customer has increased his consumption of electricity from an annual rate of 502 kw.-hr. on January 1, 1930, to an annual rate of 531 kw.-hr. on August 1, or an increase of 5.8 per cent. Concurrently with this increased consumption, the average price per kilowatt-hour has been cut from 6.18 cents on January 1, 1930, to 6.04 cents on August 1, a reduction of 2.3 per cent.

"During the first seven months of the year 860,000 kw. in new power-plant capacity has been placed in operation. Of this total, 532,000 kw. is in steam turbines and 314,000 kw. in water-power plants. Ten thousand circuit miles of transmission lines have been constructed."

▼

EDISON IN NEW ROLE

—Keystone View Co.

Passenger service on the Hoboken-South Orange (N. J.) branch of the D., L. & W. with electricity as the motive power began on Monday last, following closely the first electrified service on the Hoboken-Montclair tracks, Mr. Edison again stood at the controls as the train pulled out.

▼

Los Angeles Bureau to Spend $25,500,000

FOLLOWING action by the Los Angeles Board of Water and Power Commissioners in unanimously adopting a resolution requesting the City Council to place a power bond issue for $13,300,000 on the November 4 ballot, E. F. Scattergood, chief electrical engineer and general manager of the Bureau of Power and Light, made the following statement:

"Provision for financing certain of the items heretofore included in the previously proposed nineteen-million-dollar power bond issue is to be temporarily deferred. The principal items to be eliminated from the power bond issue as originally outlined are those providing for the construction of a transmission line from Owens Valley and of the power plants on Big Pine Creek which it was the intention of the department to build at this time."

The power construction program as adopted by the Board of Water and Power Commisioners provides for the expenditure over the three-year period ending 1933 of $25,500,000. Of this sum $12,200,000 will be provided from the surplus revenues of the Bureau of Power and Light, the remaining $13,300,000 being sought from the bonds to be voted on in November. The extensions and betterments provided for will include completion of Power Plant

VANGUARD OF INDUSTRY INVADES NATURE'S SOLITUDES

—Wide World Photos

Boulder Canyon, forming part of the Nevada-Arizona boundary, is shown on the left as it now is. On the right Secretary Wilbur, surrounded by Western governors and senators, drives the first railroad spike on the site where Hoover Dam will rise.

▼ ▼ ▼

No. 2 in San Francisquito Canyon, betterments and additions to various substations and transmission and distribution lines and $2,000,000 for purchasing rights-of-way for a transmission line from Boulder Canyon to Los Angeles.

▼

Interstate Power 13.5 per Cent, Trade Board Says

NOW virtually complete, the Federal Trade Commission's final report on the interstate movement of power will be submitted to the Senate early in December. Another interim report just made public in response to the Couzens resolution places the export of electrical energy across state lines in 1929 at 14,505,190,623 kw.-hr. Imports amounted to 15,906,132,127 kw.-hr., the difference being entirely accounted for by imports from Canada and Mexico.

On the basis of these figures the ratio of exports to electricity generated was 15.31 per cent, while the ratio of imports to electricity consumed last year was 19.65 per cent. After deducting duplications from both exports and imports where some quantities crossed state boundaries twice, the ratio of exports to total generated becomes 13.54 per cent and of imports to total consumed 17.57 per cent. The duplication in exports amounted to 1,680,746,671 kw.-hr. and in imports to 1,680,633,431 kw.-hr., the difference being due to a slight duplication at the Canadian boundary.

The total electrical energy generated and available for public use in 1929, as compiled by the commission, amounted to 94,703,518,938 kw.-hr. This total includes company use by central stations. The total consumption is reported as 80,955,774,769 kw.-hr., after excluding quantities reported to be lost and unaccounted for and estimated quantities belonging in this category for companies not reporting such figures.

The commission's final report will present quantities and ratios for individual states in some detail. A rough draft of the commission's report was completed on August 30, the day that the commission's offices were severely damaged by fire. The text was not damaged, but the appendix containing detailed tables will appear in a somewhat fragmentary form as portions of it were destroyed.

▼

Initial Millions for Building Hoover Dam

UNOFFICIAL but reliable information is to the effect that an item of $25,000,000 has been approved in the Interior Department budget for carrying on the work at Hoover Dam. The appropriation would not become available until June 30 next, and it is thought in some quarters that to expedite the work Congress may increase the appropriation by another $25,000,000.

According to reports the construction town that is being built on the Nevada side of the canyon will be called Wilbur, after the Secretary of the Interior, and not Summit, as first intended. Several chemical companies are said to intend to build plants there because of the fact that a large amount of power soon will be available, and the camp may develop into a permanent settlement. Bids for power to be used in construction are to be opened on September 29.

▼

N.E.M.A. to Gather at Old Point Comfort

ONE general meeting only will be held by the National Electrical Manufacturers' Association when it meets at Old Point Comfort, Va., in the week of Monday, October 20. This will be held on the evening of the day just named at about 9 o'clock, following a short session of the Policies Division, and will be addressed by President C. L. Collens and Virgil Jordan of *Business Week*.

The board of governors will meet Monday morning and at luncheon on Wednesday, the section council Tuesday evening, the standards committee at dinner on Wednesday evening, the casualty and fire prevention committee on Tuesday morning and at luncheon on Thursday, and the many section meetings will be spread over the four mornings—Monday to Thursday. No meetings are scheduled for the afternoons.

St. Lawrence Commission Asks Power Companies to Co-operate

WITH preliminary organization well under way, the St. Lawrence Power Development Commission appointed by Governor Roosevelt of New York under legislative authorization has expressed through its chairman, Prof. Robert N. Haig, both a desire for the "good will and active co-operation" of utility and business interests and its interpretation of the duty imposed upon it by the Legislature as embracing an "endeavor to evolve a plan for the development of the water power in the St. Lawrence by a publicly constituted power authority." Though Professor Haig does not say that his commission is limited to such an endeavor, he makes no allusion to any possible activities of the commission along other lines in case it fails to find the evolution of such a plan feasible.

Appointment of four outstanding engineers to study plans of generation and transmission was also announced by Professor Haig. This engineering board will be headed by General Edgar Jadwin, former chief of army engineers, who is chairman of the American section of the International Joint Engineering Board and in that capacity has already become familiar with the St. Lawrence problem. General Jadwin was President Hoover's first choice for head of a reorganized Federal Power Commission, but senatorial opposition developed and the President withdrew the nomination.

The three other members of the St. Lawrence engineering board are:

WILLIAM H. WOODWARD, New York—General consulting engineer; formerly associated with the United States Board of Engineers on Deep Waterways; consultant on ship canal project from the Great Lakes to the sea; member of the Isthmian Canal Commission in the early stages of the Panama Canal work; consulting engineer for many hydro-electric power developments.

O. G. THURLOW, Birmingham, Ala.—Vice-president in charge of the Southern division, Allied Engineers; engineer in charge of the design and construction of many hydro-electric projects on navigable streams in the South.

Colonel FREDERICK STUART GREENE, Albany—Superintendent Department of Public Works of New York. By arrangement with Governor Roosevelt Colonel Greene will be released from other duties to devote time to the work.

Governor Roosevelt, speaking at Plattsburg, N. Y., last week, ridiculed the idea that there was no need for further water power in the state and expressed complete confidence that his plans would be realized and bring cheaper light and power to the state at large and a vast industrial growth in the northern counties.

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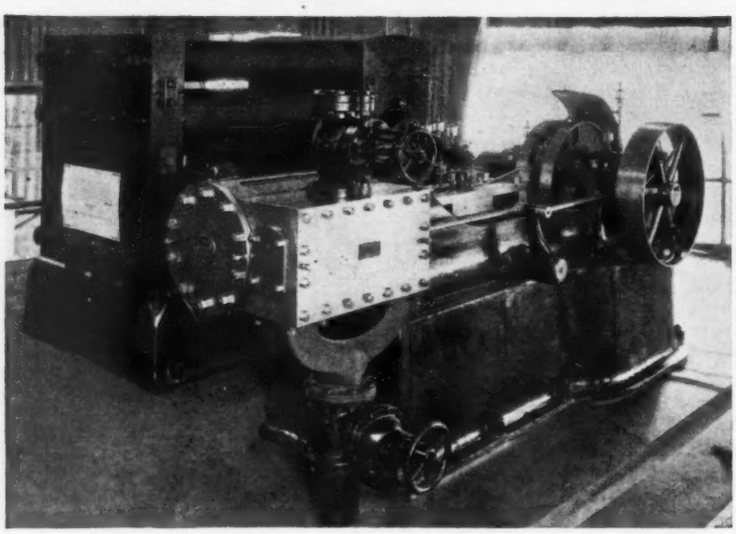
OLD EDISON "JUMBO" GOES TO DEARBORN



Henry Ford has obtained from the New York Edison Company for his museum the only remaining dynamo of the original equipment designed and built by Edison for the pioneer Pearl Street station in New York. Mr. Edison in 1882 installed six dynamos, called "Jumbos," each rated at about 125 hp., in this station. Two years later two more were installed. Seven were lost in the fire of January 2, 1890. Jumbo No. 6, the one saved, remained in peak-load operation up to 1893. Accompanying the dynamo is the Armington & Sims steam engine that drove it.

▼

Oregon Governor Thinks of Water-Power Legislation

SIX questions concerning the scope of the present laws governing water-power legislation in Oregon have been propounded to the State Attorney-General by Governor A. W. Norblad, who wishes to further the development of the natural water-power resources of the commonwealth. The questions cover rights of appropriation by a city, possibility of a private company monopolizing sites and holding them in idleness or with only perfunctory efforts at development, recapture by the state or a municipality, the withholding of action by the State Engineer or the Reclamation Commission, and details affecting fees or license tax. The Governor will, he says, be guided by the response of the law department in deciding whether or not to call a special session of the Assembly to pass upon emergency water-power legislation.

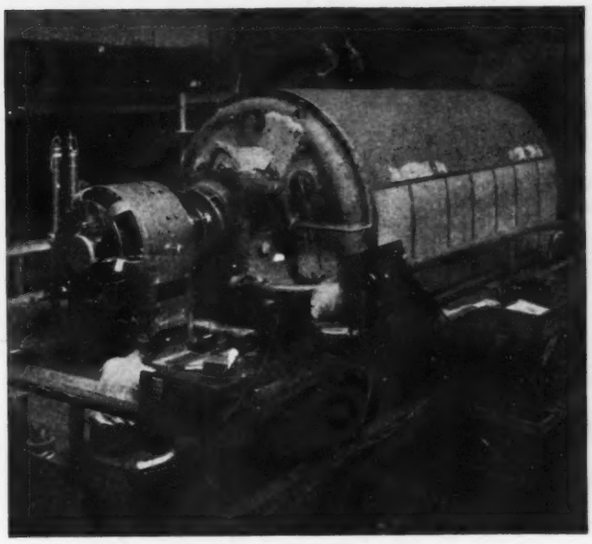
The Governor's questions may perhaps have been suggested by the decision of the city of Salem to file an application with the State Engineer for a permit to appropriate 650 sec.-ft. of water from the North Fork of the Santiam River and tributaries for domestic, irrigation, manufacturing and power purposes in Marion County. This filing is upon power sites covered in applications previously filed by the Northwest Power Company of Portland, and the city will attempt to establish that the former's applications are now without force and effect on the ground that the river in question was withdrawn from appropriation by private individuals prior to the utility's filings. (ELECTRICAL WORLD, August 23, page 337.)

▼

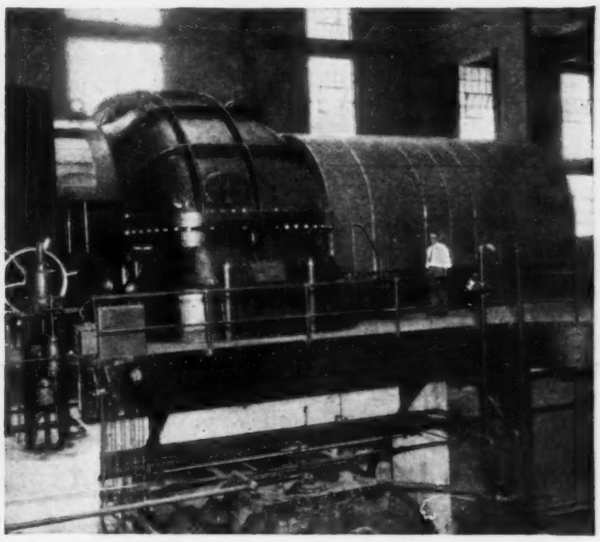
Atkinson Steam Plant to Be Dedicated Soon

WORK has been virtually completed on the 75,000-kw. Atkinson steam plant of the Georgia Power Company, on the Chattahoochee River near Atlanta, one of the largest steam power stations in the Southeast, and formal opening will take place on October 17. Since August 20 satisfactory test runs have been conducted. The plant is designed for ultimate size of 300,000 hp.

KEEPING UP WITH CLEVELAND'S GROWTH—AND WITH BUFFALO'S



Testing the second of three 50,000-kw., 1,800-r.p.m turbo-generators built for the Cleveland Electric Illuminating Company at the Schenectady works of the General Electric Company



This 75,000-kw. G.E. turbo-generator is now in service at Huntley station, Buffalo (ELECTRICAL WORLD, *September 6, page 420). Two of 80,000 kw. are to follow, one very soon*

▼ ▼ ▼

Urge Reforms at Meeting of New York Utility Men

"PUBLIC utilities cannot be privately conducted," G. E. Cox, investment counsel, told the members of the Empire State Gas and Electric Association at the twenty-fifth annual convention at Saranac Inn, N. Y., last week in urging uniformity and greater frankness in financial statements. "It is not necessary to say what the public is entitled to know," Mr. Cox continued. "Whatever interferes with the serene operation of utilities, making them uncertain, is detrimental to investment in utility securities. Valuation of properties here comes in with a vengeance. The investor is vitally interested to know whether he is paying for 'water' when 7 per cent is allowed on an investment. What if some public inquiry should disclose that many properties on which 7 per cent is allowed are worth little?

"Political attacks cannot be waved aside," went on the speaker, "whether they are soundly based or are the mere product of the desire for bribes in cash or in political position. It might be a good thing for gas and electric power companies if they were to find some Judge Landis or Will Hays to correlate and criticise their own activities as they relate to the public rather than risk outside hostile interference and regulation. It is not so much a question whether the public ought to be given information—the public will get it. The investor is the Nemesis of secrecy."

Other speakers included W. A. Jones, president of the National Electric Light Association, who traced the electrical progress of the past quarter century and urged more rational rate structures; Milo R. Maltbie, chairman New York Public Service Commission, who, as reported briefly last week (page 507), urged full publicity on rates and charged that certain New York utilities had secret preferential contracts; E. J. Cheney, consulting engineer, who discussed the possibilities of uniform and permanent cost analyses; Wheeler McMillen, associate of *Country Home*, who outlined the opportunities in full and efficient rural service, and William J. Welsh, president of the association.

About 100 members and guests attended the meetings. Under the new constitution and bylaws, officers are no longer elected by the members but are to be appointed by the executive committee. No announcements of officers for the coming year have been made.

▼

North Carolina Towns Vote on Sale of Plants

SPINDALE and Rutherfordton, N. C., have voted by great majorities to sell their municipal electric light and water plants to the Southern Public Utilities Company at Charlotte. Rutherfordton will receive $205,000 for its electric system and Spindale $95,000.

Sale of Forest Hill's (N. C.) municipal light and power plant to the same company was apparently defeated last week by the margin of a single vote. Of 770 registered for the election, 385 voted for the power plant sale, 242 against and 143 did not vote, the move being lost through the bare failure to get a majority of the total registration.

▼

Klamath Falls Project Held Up by Opponents

PERSISTENT agitation over public ownership in Oregon is causing the California-Oregon Power Company's plans to start development of the hydroelectric site on the Klamath River for which it recently acquired a license from the Federal Power Commission to be delayed. Citizens of Klamath Falls and southern Oregon are divided, the merchants in general being said to be eager for the company plant while advocates of public plants, including farmers on irrigated land, want the state authorities to withhold final sanction of the development until it is known whether the Grange power district bill is adopted or rejected at the November election. They also want to wait to see whether the Legislature wishes to pass laws which will produce more revenue from power companies or wishes to withhold all water sites for the public to develop.

The possibility that the plant may be built in California, just across the line, if Oregon refuses a permit, is pointed out.

West Penn Power Helps Navigation Over Drought

COMPLETE cessation of navigation on a section of the Monongahela River, with resultant closing down of many industrial plants along its banks, unemployment of thousands and loss of millions, was averted recently through co-operation by the West Penn Power Company with the federal government. Colonel Jarvis J. Bain, United States engineer for the Pittsburgh district, has just revealed that the navigation pools have been kept as near normal as possible by virtue of periodic releases of water from Lake Lynn, the power company's huge reservoir on the Cheat River in West Virginia. These releases were made practicable by the ability of the Duquesne Light Company of Pittsburgh, with its great steam plants, to stand by the hydro company in case the latter got into difficulties itself through aiding the government.

Three navigation pools were filled to their crests from the company's storage reservoirs, this operation being completed on September 17. With 18,900,000,000 gal. still available in Lake Lynn, which the West Penn Power Company stated could be drawn down to its very bottom if necessary, navigation can probably be sustained even if the drought continues throughout the remainder of the present year. Thus private hydro-electric enterprise and the policy of interconnection, backed by the public spirit of the utilities, have saved the day for the federal engineers and prevented probably the serious interruption of navigation on the Monongahela River.

Similar drought conditions occurred in 1881 and 1908, but the present condition appears destined to break all records. The average monthly river tonnage on the Monongahela in 1908 was, moreover, only about 800,000 tons compared with more than 2,000,000 tons at present.

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Ontario Hydro Buys Three Foshay Properties

COURT authorization has been given at Minneapolis to the sale of the Canadian utility properties of the Public Utilities Consolidated Corporation—one of the W. B. Foshay companies now in liquidation—to the Ontario Hydro-Electric Power Commission for $481,000 and the assumption of $52,000 liabilities. The plants sold are the Western Electric Power & Light Company, the Saugeen Electric & Power Company and the Saule Falls Power & Light Company, all in the Georgian Bay district.

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Wholesale and Commercial Rates in Georgia

NOVEMBER 17 has been set by the Georgia Public Service Commission as the date by which the Georgia Power Company shall furnish particulars of proposed wholesale, commercial and municipal electric rates. The commission will then fix the time for a hearing as to why such rates should not be made uniform in territory served by the company.

At the preliminary hearing on the case President Preston S. Arkwright of the Georgia Power Company said that should the rates fixed by the commission for north Georgia be made uniform throughout the state, the power company's revenue would be reduced by approximately $400,000 annually. He said that the company would be unable to stand such a reduction in revenue, because orders of the commission during the past two years had cut its revenue more than $2,000,000. Mr. Arkwright asked a postponement until data now being compiled on rates could be completed.

Cotton manufacturers in the territory, who are leading the movement for lower and more uniform power rates, agreed to the postponement, but asked that the power company submit its proposed rates 30 days in advance of the hearing.

This issue is distinct from that now before the courts and brought about by competition at Cordele with the new county plant there (ELECTRICAL WORLD, September 13, page 465).

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Centralia's Municipal Plant Near Completion

ENGINEERS in charge of the million-dollar municipal hydro-electric project of Centralia, Wash., announce its early completion. The plant is near Yelm, on the Nisqually River, and will produce about 15,000 hp. A 25-mile transmission line from Yelm to Centralia is ready. The last of a long series of lawsuits involving Centralia's rights in this project will soon be heard in a federal court at Tacoma. The city desires to condemn the water rights which the Puget Sound Power & Light Company contends it owns on the Nisqually River between the city's dam and power site, and the power company is seeking to prevent it from doing so.

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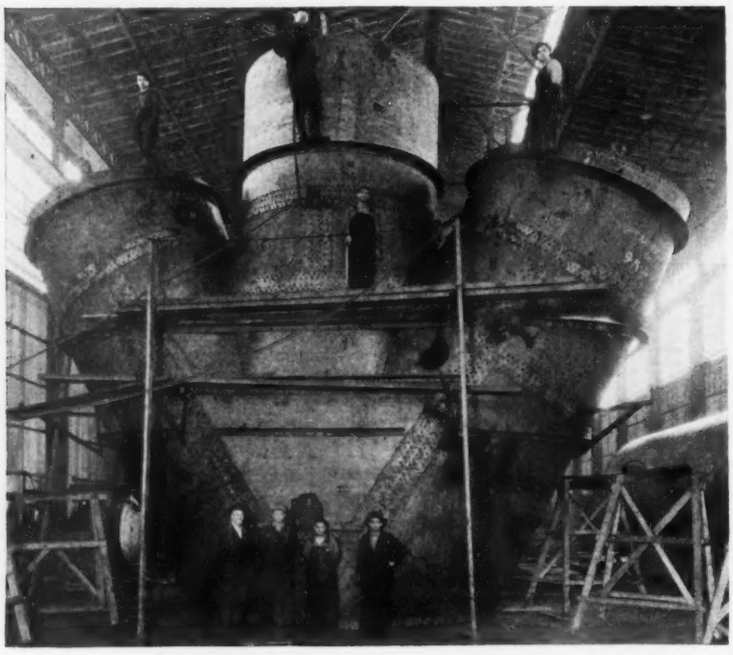
TACOMA GETS READY FOR CUSHMAN NO. 2



Tacoma, Wash., is preparing to increase its municipal power supply by means of a second generating plant at Lake Cushman. This triple pipe, said to be the largest manifold ever constructed, was manufactured for it at the South San Francisco plant of the Western Pipe & Steel Company of California.

Coming Meetings

National Safety Council—Pittsburgh. Sept. 29-Oct. 4. W. H. Cameron, 20 North Wacker Drive, Chicago.

New England Division, N.E.L.A.—New Ocean House, Swampscott, Mass., Sept. 29-Oct. 1. Miss O. A. Bursiel, 20 Providence St., Boston.

Illuminating Engineering Society—Hotel John Marshall, Richmond, Va., Oct. 7-10. E. H. Hobbie, 29 West 39th St., New York.

Public Utilities Advertising Association—Atlantic City, Oct. 10 and 11. J. R. Pershall, 72 West Adams St., Chicago.

Empire State Gas and Electric Association—Meter Section, Watertown, N. Y., Oct. 9 and 10. C. H. B. Chapin, Grand Central Terminal, New York.

American Institute of Electrical Engineers—Middle Eastern District, Philadelphia, Oct. 13-15; Southern District, Louisville, Nov. 19-22. F. L. Hutchinson, 33 West 39th St., New York.

American Engineering Council—Administrative Board, Mayflower Hotel, Washington, Oct. 17 and 18. L. W. Wallace, 26 Jackson Place, Washington.

Rocky Mountain Division, N.E.L.A.—Franciscan Hotel, Albuquerque, N. M., Oct. 20-22. O. H. Weller, Public Service Co. of Colorado, Denver.

National Electrical Manufacturers' Association—Chamberlain-Vanderbilt Hotel, Old Point Comfort, Va., Oct. 20-24. A. W. Berresford, 420 Lexington Ave., New York.

National Electrical Wholesalers' Association—Pittsburgh, Nov. 10-14. E. Donald Tolles, 165 Broadway, New York.

National Association of Railroad and Utilities Commissioners—Charleston, S. C., Nov. 12-15. J. B. Walker, 270 Madison Ave., New York.

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New York Edison Rate Hearings to Be Speeded

LITTLE progress was made in settling rates for the New York Edison and its allied companies when the Public Service Commission of the state resumed its hearings in New York City on Monday. Corporation Counsel Hilly re-examined Secretary R. B. Grove of the United Electric Light & Power Company and Vice-President F. H. Nickerson of the Consolidated Gas Company on financial matters.

The city's representative quoted from the annual reports of the companies to the Public Service Commission to show that the utilities had paid 5 and 6 per cent for borrowed money in several cases and that funds of the companies had been invested in common stocks on which no dividend is being paid. Mr. Hilly argued that these figures were at variance with the claims to an 8 per cent carrying charge.

When the hearing was resumed on Wednesday an agreement was come to that the companies would, without prejudice to any future rate case, agree in this instance to substitute 6 per cent for 8 per cent as the rate of return on carrying charges. This concession, made to expedite the hearings, makes the average annual meter cost set up by the company $12 instead of $12.74. The company is asking permission to make a service charge of $7.20 a year.

Hearings were to continue on Thursday and Friday. President Sloan was expected to testify on Friday.

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Bagnell Dam Wins in Federal Court Fight

VIRTUALLY the last obstruction in the path of the Union Electric Light & Power Company's great hydro-electric dam and power project on the Osage River at Bagnell, Mo., was removed at Jefferson City last week by a federal court decision permitting the condemnation of streets, sewers and sidewalks in Linn Creek, the county town which will be inundated by the waters impounded by the dam. As previously reported, citizens of Linn Creek have waged a determined battle against the plant.

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New York Commission on Utility Capitalization

GENERAL rules for the capitalization of public utility capital expenditures in the future are set up in an opinion just handed down by Chairman Milo R. Maltbie of the New York Public Service Commission. Under these rules the opinion specifically states the manner in which the proceeds of financing are to be appropriated in order to repay outstanding indebtedness of the company concerned. Mr. Maltbie also refuses to permit the company to put its depreciation and retirement reserve into the form of cash, holding that no proof of necessity was presented.

The company concerned is the New York Steam Corporation, which applied for consent to issue 112,000 shares of non-par-value stock at $50 per share. The commission of its own accord raised the number of shares to 120,000 in order to permit the offering of one new share to stockholders for each two now held, thus eliminating to a large extent fractional rights and shares.

The opinion disapproved an arrangement whereby the Consolidated Gas Company of New York, a large stockholder, was to have the right to purchase at the subscription price of $50 a share all stock not taken by other shareholders in the company. With regard to the legality of the ownership of stock in the steam corporation by the Consolidated Gas Company or its subsidiaries, Mr. Maltbie held that this had been called into question too late. Another quotation from the opinion says:

"It has been stated that there are certain advantages of unified control of the steam and electric systems. There are certain economies which have been made possible. These advantages and economies could doubtless have been effected without unified control, and as yet there has been no tangible evidence that the economies thus obtained have in part or in whole been passed on to the public through adequate reductions of rate. Possibly this may be done in the near future, but it has thus far not been accomplished."

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FINDING NEW WATERS TO CONQUER

—Amtorg

The Old World is the New when it comes to conquests of rivers by Colonel Hugh L. Cooper. With Keokuk, Holtwood and Wilson dams behind him, he is here shown in Russia in command at the harnessing of the Dnieper River for the Soviet government.

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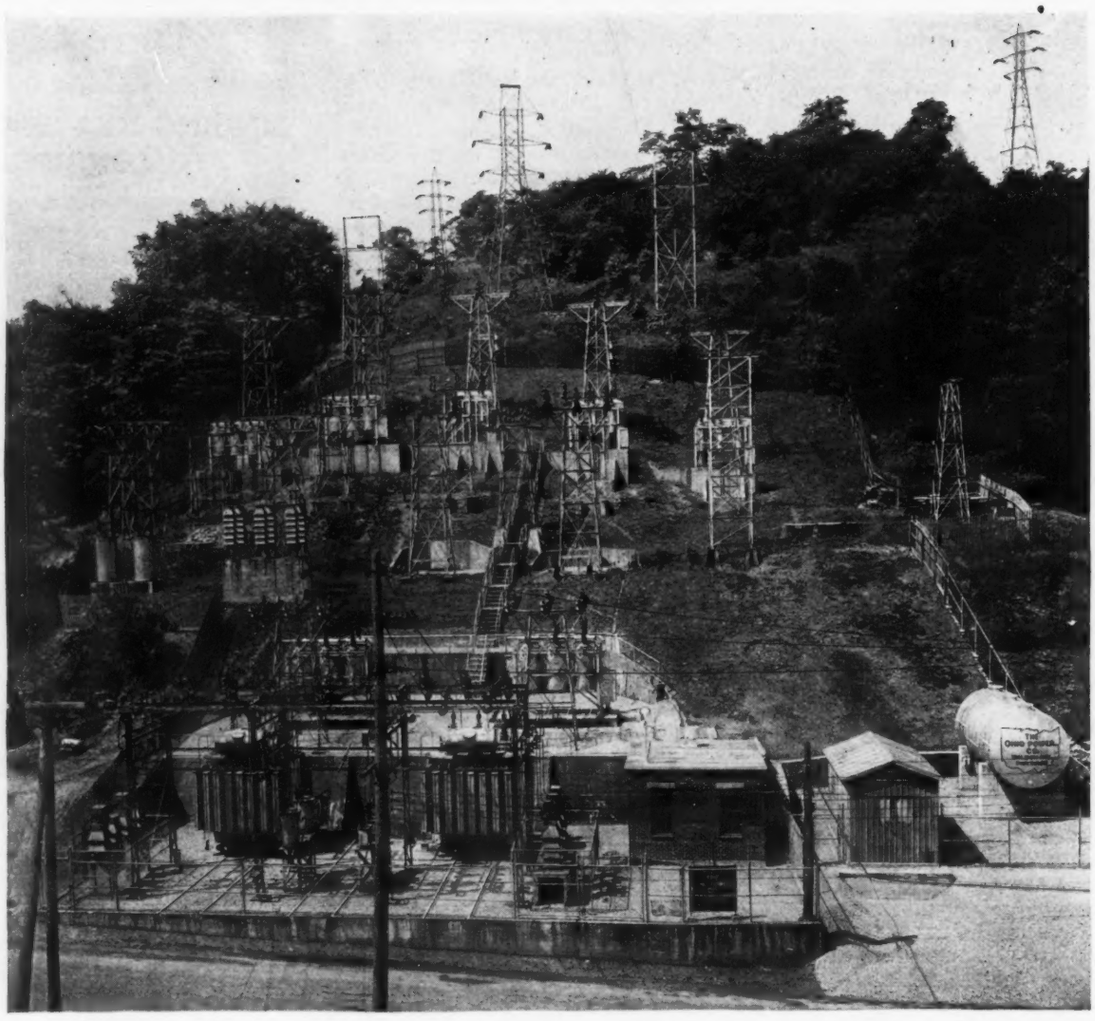
Indianapolis Obstructs Power Company's Plans

SUIT has been filed by the city of Indianapolis in the Circuit Court to enjoin the Indianapolis Power & Light Company from constructing a dam across White River, on the ground that the river would become stagnant and prove a detriment to health and civic expansion.

The dam is planned by the company to provide water for condensing purposes for the sixteen-million-dollar plant it is to build on the outskirts of the city.

ADAPTED TO A HILLSIDE LOCATION



THE Wilson Avenue outdoor substation of the Ohio Power Company in Steubenville is so arranged that six incoming lines swing to meet low tower construction at the highest elevations within the station inclosure and at successively lower levels encounter oil circuit breakers, buses, disconnecting switches, lightning protective equipment, transformer high-tension breakers, transformers and low-voltage facilities. According to Philip Sporn, electrical engineer American Gas & Electric Company, no significant engineering compromises were necessary and the station is operated as readily as the usual type.

EDITORIALS

L.W.W.MORROW
Editor

Dollar engineering governs

MODERN electrical engineering in the utility and industrial fields is concerned largely with economic and service values. Despite some opinions to the contrary, there is little evidence that the modern motor, generator, lamp, meter and other fundamental electrical machines will be improved or changed greatly or will be displaced by new discoveries. It is, therefore, in assembly, in accessories and in operation that engineers find opportunity to exercise their skill; and in this realm results are measured in the cost of achievements.

IN THIS ISSUE are a large number of articles dealing with electrical design and construction. They represent examples of the newest and best practices that could be found in an intensive survey of the fields of engineering. They are thought to be valuable in that they concern installations that are either better or safer or cheaper.

BUT THE STRIKING THING about the design and construction situation as illustrated in these articles is the lack of standardization. For many similar applications no two engineers make the same electrical connections, physical layout or selection of equipment. Everywhere schools of tradition, opinion and design exist. Each organization of engineers may get a good and economical installation by reason of its individual solution, but, from the point of view of the industry as a whole, lack of standardization is lack of economy. Reduced engineering costs, equipment costs and time delays with their consequent capital and labor savings result from standardization.

ENGINEERS REALIZE that these conditions should be changed and are at work to change them. They have done a great deal to standardize pole tops, switchboards and relays. They have done much to standardize accounts and construction equipment and methods. But in the generating station, transmission line, substation, distribution system and industrial plant there are many functional tasks that are not standardized.

COMPARISON OF PRACTICES will reveal opportunities. Electrical connections, physical structures and electrical equipment used by several groups for similar purposes will show obvious reasons for definite standardization. The editors of the ELECTRICAL WORLD hope to help in this work during succeeding weeks by publishing examples of comparative practices. They believe that dollars will be saved and service improved through simplification and standardization.

Buying for merit

PERIODS of industrial depression afford opportunities for merit buying based upon a closer analysis of the economics underlying the application and use of equipment. Economy can be made something else than penny pinching or the purchase of equipment low in first cost only.

Major equipment items involving large unit sums of money usually get analytical attention, and research receives recognition in purchasing; but there is a tendency to buy on a price basis small devices such as disconnecting switches, fuses, motor starters, air breakers and other accessories. These items are individually inconspicuous and too frequently are treated as poor relations by executives and senior engineers.

In degree of industry importance, however, the accessory items in equipment assemblies rank very high. They are essential elements of the assembly, and in the matter of service continuity and quality they have as much consequence as the larger units, if not more. In the national aggregate the quality of this trend of equipment will be fixed by the encouragement given manufacturers to use originality and research in developing new and better devices. Most of these devices require high-grade mechanical and electrical engineering skill for proper design, and every encouragement should be given equipment manufacturers to focus engineering talent upon their improvement. Manufacturers can and will do this if buyers recognize the importance of the devices and adhere to a fair purchasing policy.

The Faraday celebration—a career and an invention

NEXT year the British Empire will have a Faraday celebration. There is world-wide significance in the one hundredth anniversary of the discovery of the principle of electromagnetism that brought forth the motor and generator. Prof. Joseph Henry and Michael Faraday simultaneously broke through the crust of the unknown to make possible the electric light and power industry. They found that electricity could make magnetism and that magnetism could make electricity—the electromagnetic principle.

Michael Faraday was born in 1791, the son of a blacksmith. In early youth he struggled as a bookbinder's apprentice and his handicaps seemed insurmountable, but he read books as well as bound them and at last seized an opportunity to tell Sir Humphry Davy of his desires and ambitions. Thus Davy found Michael Faraday and gave him an opportunity. From 1822 to 1831 Faraday had the idea of converting magnetism into electricity. He never gave up until he found the solution to this problem.

The Faraday celebration is more than a tribute to a great inventor. It is a tribute to a man whose personal ability and initiative changed a good bookbinder into a world-renowned scientist.

Better, safer and quicker

THE magic touch of the electrical engineer improves his apparatus year after year. The motor looks about the same as it always did except for the advantages accruing to its production and appearance through welded fabrication. Yet it is better and more reliable and has taken on a multitude of special characteristics to make it a better tool for industrial production. Synchronous motors especially are now designed to do work for which they were for many years considered unsuitable.

But after the designer gets through doing all he can for the motor he looks at its accessories. He has made marvelous strides in control equipment whereby he makes the motor jump over industrial fences and through hoops that look impossible of negotiation. The alternating-current motor can be controlled in speed to one-tenth of 1 per cent; a gang of motors can be electrically geared with efficiency and precision; the speed adjustments can be made equal to those of direct-current motors; starting, pull-out and operating characteristics can be made to schedule through manual, automatic or remote manual control. The hand, the foot, the push-button, the air blast, the thermocouple, the magnet and the vacuum tube can be made triggers to start any desired sequence of operations for one or more motors.

These changes in motor design and motor control are fundamental sales elements in industrial modernization. They make uneconomical and

obsolete equipment and processes introduced only a few years ago. Too few power salesmen and industrial-plant engineers know what has been done recently with motors and controls. Yet they should know, from the point of view of cost reduction in manufacture and efficient selling and engineering; they are paid on this supposition. The market for electrical motors and control is largely a replacement market. It has been neglected too long because industrial engineers and engineering salesmen neglect to keep informed of progress and to apply this knowledge.

Automatics are proved

AUTOMATIC operation of system units has been having its trial, and the experience is rapidly showing the circumstances which make it practicable. In the field of the hydro station we have a clear-cut picture of its merits and limitations because the variables to contend with are relatively simple. The hydraulic power committee of the N.E.L.A. has just reported that "the automatic idea is a success, both technically and economically." Steam-station costs are running neck and neck with hydro costs and thus forcing a more critical analysis of operating budgets of water plants. The general experience is that costs can be reduced and operating time and reliability enhanced by automatic operation of the hydro plants. In spite of the intricacy of the control devices, they are quicker, surer and less dependent on moods and idiosyncrasies than the best of human operators in the event of an interconnection emergency.

The question is primarily one of dollar balance after the scheme has been devised which adequately correlates all essential factors in their proper sequential arrangement, both starting and stopping. But in devising the automatic composite care must be taken to stop short of introducing automatic control of too many minor factors. Situations where full automatic operation is essential to supplant attendance, and where partial automatic operation would have no merit, are one thing. Steam plants and heavy-duty substations are another; here the logical procedure is to incorporate those functions in which automatic devices are known to surpass human interpretation, reliability and response. Caution should be exercised not to extend automatic operation to the stage that leads to more intricacy and complexity in the control equipment than exists in the circumstances to be controlled.

Trends in power generation

DESIGN of steam stations continues to undergo changes and modifications that make for cost reductions and operating simplicity and reliability. Sufficient evidence has been obtained to place reheating, preheated combustion air, forced ratings, high pressure, high temperature, steam bleeding and other recent developments more securely in their application aspects.

There is little doubt that for power stations producing from 10,000 kw. to 60,000 kw. with several generating units, where coal is comparatively cheap and the load factor rather low, operation at 400-pound steam pressure and 725-degree temperature has economic as well as operating advantages.

Another group of stations undoubtedly will use 600-pound pressure and 825-degree temperature. These stations will not reheat steam as a general practice and will be largely those rated at from 50,000 kw. to 200,000 kw., operating on comparatively low load factors and using comparatively cheap fuel. Fair-sized single-cylinder turbines can be used to advantage, and a comparatively cheap, simple and reliable station design may be had. Despite the popularity of the very high-pressure station, there is little doubt of the economic and operating advantages of the 600-pound type for most extended transmission properties.

But the trend toward the 1,200-pound and 800-degree station, with reheating and multiple bleeding and feed-water heating, will continue for the large metropolitan stations and others that operate on a high load factor and use comparatively expensive fuel. The first cost and complexity are justified because of economic gains and greater reliability, and simplicity will be developed continuously as more experience is gained.

Thus the three pressure divisions for power stations appear to be placed rather firmly for the current building period, but there is little doubt that shifts will occur rapidly, and no one is warranted in building a station to operate under present conditions for a very long period.

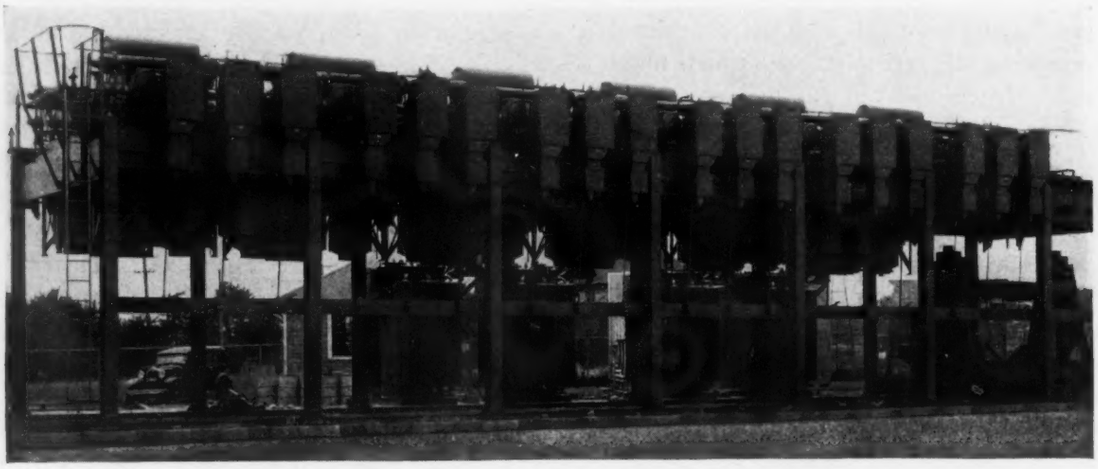
Progress in Metal-Clad

CHANGES that have come about in the design of metal-clad switchgear in the past two years have been merely those that always follow upon the introduction and first acceptance of an idea. The design undergoes refinements that make operation smoother and easier and that facilitate production and installation. This is what has happened and is continuing to happen with the metal-clad gear. Changes have not been radical. But while the word "merely" is used to characterize the recent developments, it must not be taken as applying to their value and importance. The refinements of design that have resulted in greater compactness, better utilization of inclosed space, better arrangement and use of materials, improved factory production methods, easier installation and more satisfactory performance are marks of definite progress and have their effects on the attitude of engineers toward the new development.

From its experience with this type of equipment the Public Service Company of Northern Illinois has arrived at certain conclusions as to its value and practicability. The conclusions, which have already been stated or intimated (ELECTRICAL WORLD, March 30, 1929), have now the added weight of about two more years of experience which comes from the continuation of the policy of installing the gear where new substations are built or additional switching facilities are required

The use of the metal-clad equipment, which is virtually a complete factory-assembled product, simplifies engineering and construction in comparison with older types such as the outdoor open or the indoor masonry-cell varieties. The company has virtually abandoned the masonry-cell construction with its many details—mechanical, building and electrical—and has not installed any of this type since 1925. It has been found that the total cost of the metal-clad gear, considering all phases of the problem, including engineering, construction, operation, maintenance, salvage, retirement and appearance, continues, as was first expected, to compare favorably with the cost of the open type and has in addition many inherent advantages, not the least of which is safety, on which, however, it is difficult to place a valuation.

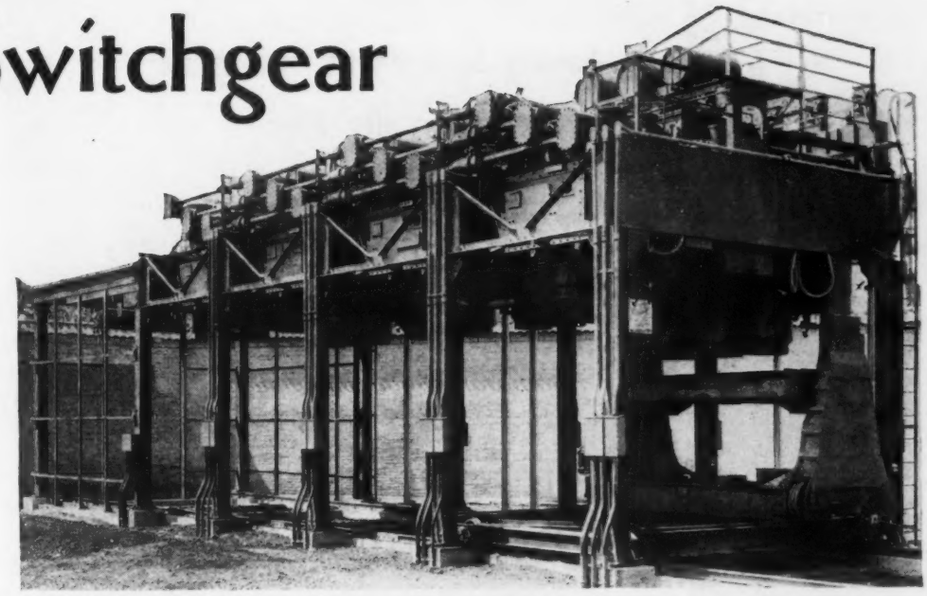
Soon after the publication in the ELECTRICAL WORLD of the article just referred to two other installations of 33,000-volt gear—these of Allis-Chalmers manufacture—were placed in service in the Highland Park and Electric Junction substations on the Public Service system. The experience gained with these and the earlier installations has fully justified the company's policy, and it has recently installed and placed in service three important substations embodying this kind of equipment. These substations are shown in the accompanying pictures.



For industrial supply

This substation, situated in the industrial area of Joliet, Ill., functions as a switching center for several 33,000-volt transmission lines, in addition to supplying 2,300/4,000-volt distribution service to the immediate area. This switchgear was manufactured by the Westinghouse Electric & Manufacturing Company. The picture was taken during construction. The compactness of this equipment is easily recognized, and the ease of installation can be better appreciated when it is known that the individual bays, completely equipped with all buses and connections in place and filled with oil, were shipped from the factory as units, it being necessary only to mount the complete bays on the supporting columns in the field and insert the oil circuit breakers. As may be noted, it appears that certain of the oil circuit breakers are missing. This being a double-bus arrangement, it is possible to equip certain of the positions with only one circuit breaker, as any particular breaker can be quickly and easily disconnected and moved to any portion of the structure into any vacant position, when required. This arrangement still gives the advantages of the double-bus flexibility with a decrease in cost. These vacant positions can, of course, be filled permanently at any time.

Switchgear



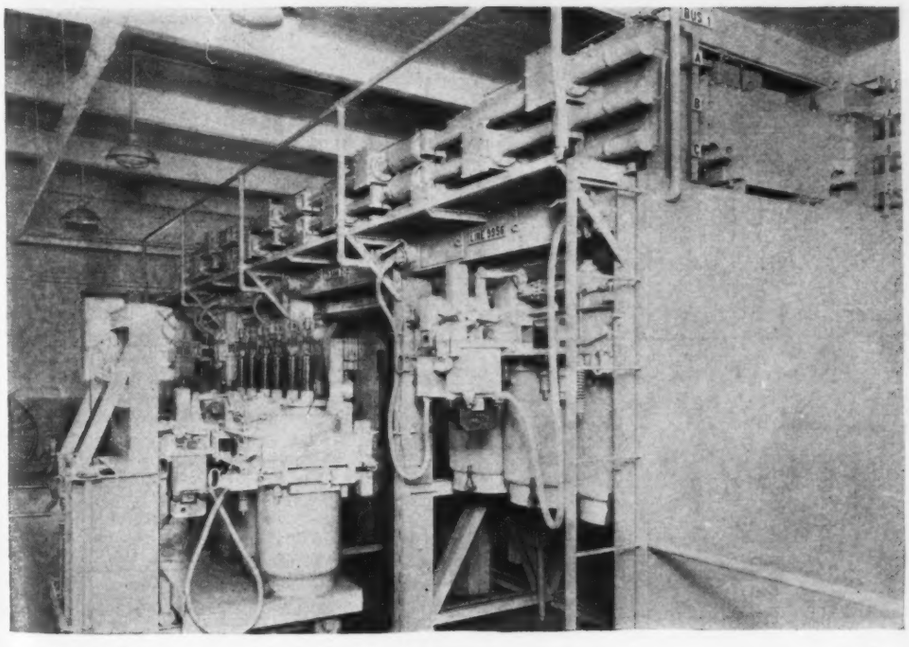
Clean-cut appearance

The 33,000-volt outdoor metal-clad switching equipment in the Wilmette substation was manufactured by the General Electric Company, and the initial installation provides positions for two lines, two 10,000-kva., three-phase transformers and an inspection bay. Each of the buses has a continuous capacity of 600 amp., and the oil circuit breakers likewise have a normal rating of 600 amp. with an interrupting capacity of 750,000 kva. This view shows one of the oil circuit breakers in the "disconnect" position, and below it is the traveling carriage which is used for lowering and transporting the breakers. One of the oil-filled metal-clad buses with its connecting boxes is also shown at the top of the structure.

Metal-clad switchgear of Allis-Chalmers manufacture, Reyrolle design, is installed within the building.

Behind a monastery wall

That's what the picture suggests, but as a matter of fact this is the new Wilmette substation of the Public Service Company of Northern Illinois, containing two of the newest installations of metal-clad switchgear. One is in the yard and the other inside the building. The new gear was found to be particularly applicable to this substation, which is in a highly restricted residential area, because of its compactness and pleasing appearance.



The indoor type

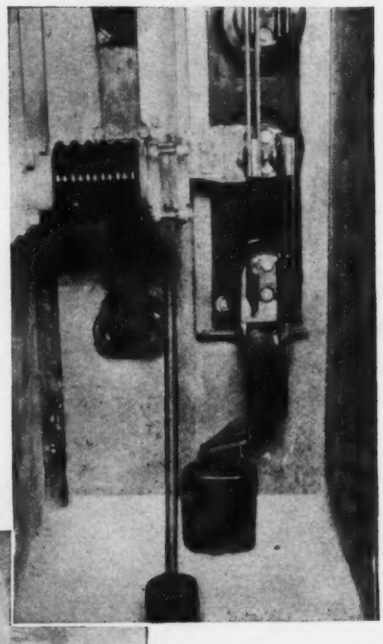
Another installation of the metal-clad switchgear which has just recently been completed at the Berwyn substation consists of a 12,000-volt oil-filled indoor installation manufactured by the General Electric Company. This switchgear is quite similar to the Wilmette gear, except that it is for indoor service. Each of the buses of this double-bus arrangement has a 1,400-amp. continuous capacity, with oil circuit breakers of 600 amp. normal capacity and an interrupting capacity of 560,000 kva. The accompanying 2,300/4,000-volt switchgear for taking care of the distribution facilities is also of General Electric Company manufacture and is compound-filled with the vertical draw-out arrangement for the oil circuit breakers.

Saving Space with Rheostats Horizontally Placed

The rheostats for the primary air fans at the South Amboy station of the Jersey Central Power & Light Company were mounted horizontally, with appreciable space savings and considerable improvement in appearance. Note the "telephone panel" type of wiring, which likewise added to the neatness of the job.

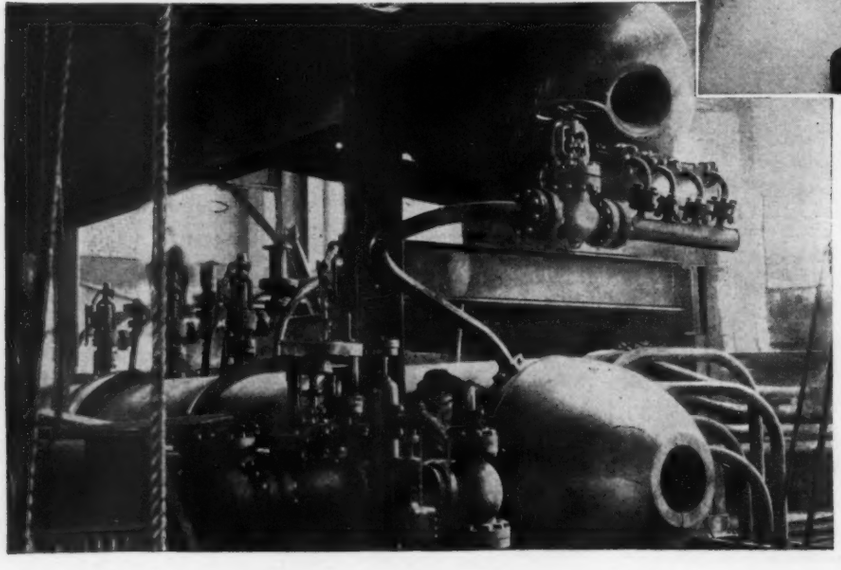
SPACE ECONOMIES

Offset Copper Bus Bends Cut Space Requirements



By carefully planning for space requirements and clearances, the Electric Management & Engineering Corporation showed many economies at the new South Amboy steam station of the Jersey Central Power & Light Company. The accompanying illustration shows how the main bus from the 13.2-kv. generators (left) is brought to the double-throw switches serving main and transfer buses. Offset bends of flat copper were used here to advantage.

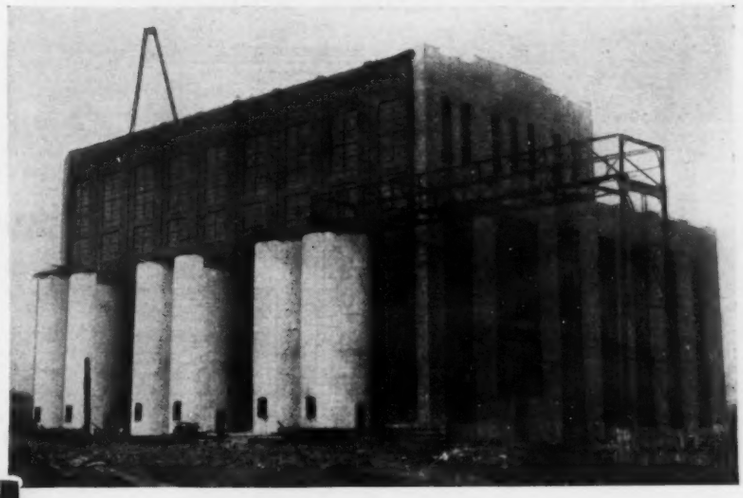
Reheaters Above Boiler Drum in 1,400-lb. Installation



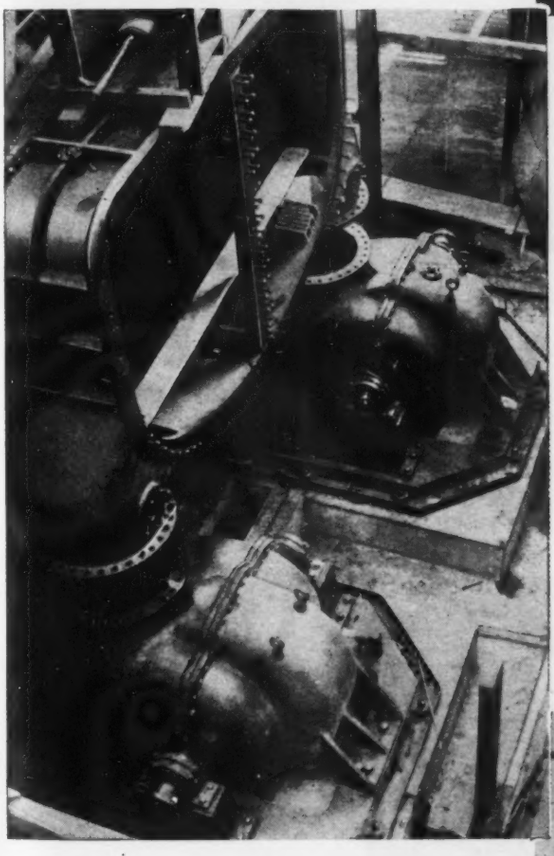
By locating the 26-ft. long by 45-in. diameter riveted steam reheater directly above the main boiler drum at the South Amboy station of the Jersey Central Power & Light Company not only was a short pipe connection permitted but better drainage arrangements were secured. Reheating steam goes from the steam drum at 1,400 lb. to the upper end of the inclined reheater drum, passing through the reheater tubes and draining from the lower end through a control valve. The exhaust steam from the high-pressure turbine at 400 lb. pressure passes around the tubes and thence to the gas reheater and back to the low-pressure turbine.

Coal Silos Eliminate Station Steelwork

All coal at the South Amboy station of the Jersey Central Power & Light Company is stored out of doors, thus eliminating inside bunkers and saving considerable supporting steelwork. From boat, car or yard, storage fuel is taken to the breaker house and after crushing is brought by belt conveyors to six 125-ton reinforced concrete silos. From the silos the fuel goes by gravity to the pulverizer mill feeders and thence through indicating and integrating scales in the boiler room basement to the pulverizers.



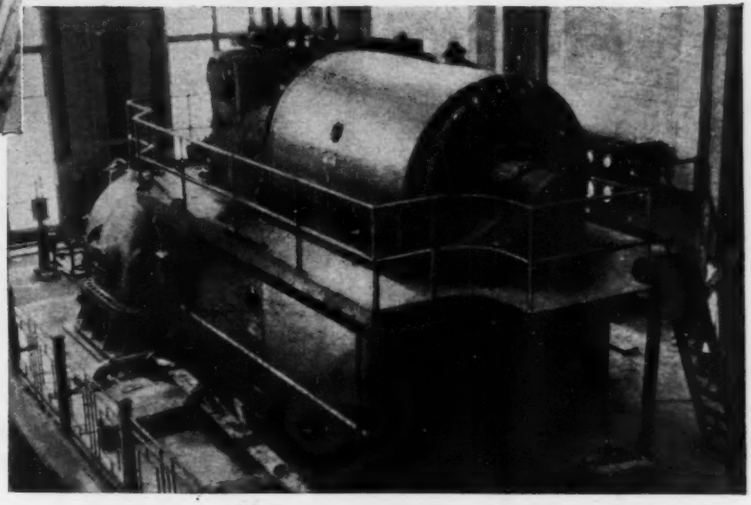
AT SOUTH AMBOY



Vertically Split Pumps Save Turbine Room Space

Notable space savings were realized in the construction of the new South Amboy steam station of the Jersey Central Power & Light Company through careful planning, particularly in the selection of individual items of equipment and in the arrangement of functionally related parts. In selecting the centrifugal condenser circulating pumps the possibilities of advantageous selection were fully developed and as a result two pumps per unit, each of 21,000 gal.-per-minute capacity at 14-ft. head, of vertically split, bottom-suction top discharge type were selected. These are driven by 200-r.p.m., 100-hp., 440-volt motors. The condensers served are of 20,500-sq.ft. surface each. The use of these vertically split pumps permitted a saving of several feet in the width of the condenser room and a related saving in the size of the whole structure.

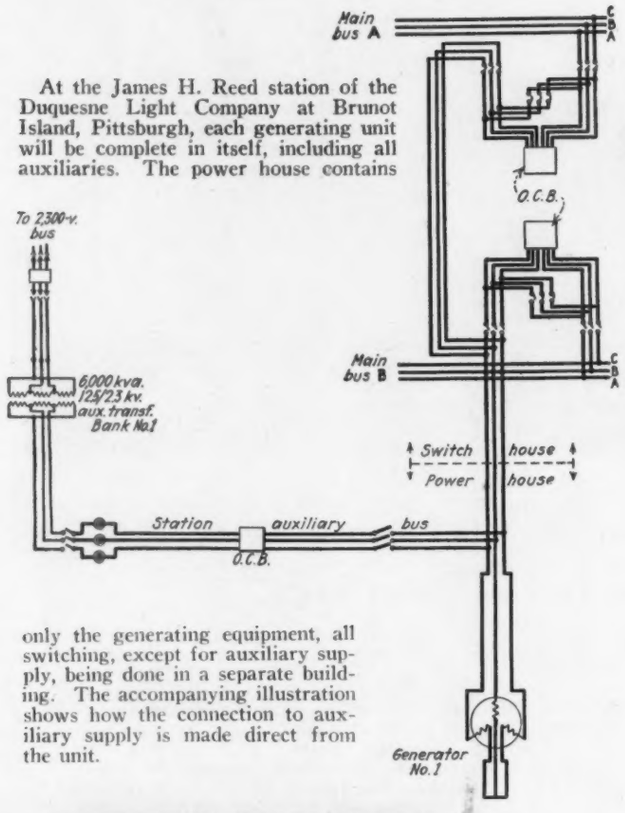
Vertical-Compound Turbines Show Space Savings



In the South Amboy steam station of the Jersey Central Power & Light Company two 25,000-kw. General Electric vertical-compound turbo-generators have been installed. Ultimately a third unit of the same rating and design will be placed in the turbine room between those now in place. If the high- and low-pressure units had been placed on the same floor level the future unit could not have been installed in the present turbine room.

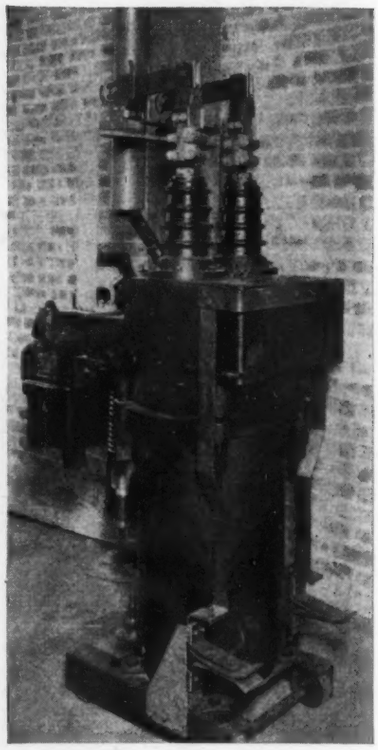
Generator and Auxiliaries Constitute a Working Unit

At the James H. Reed station of the Duquesne Light Company at Brunot Island, Pittsburgh, each generating unit will be complete in itself, including all auxiliaries. The power house contains only the generating equipment, all switching, except for auxiliary supply, being done in a separate building. The accompanying illustration shows how the connection to auxiliary supply is made direct from the unit.

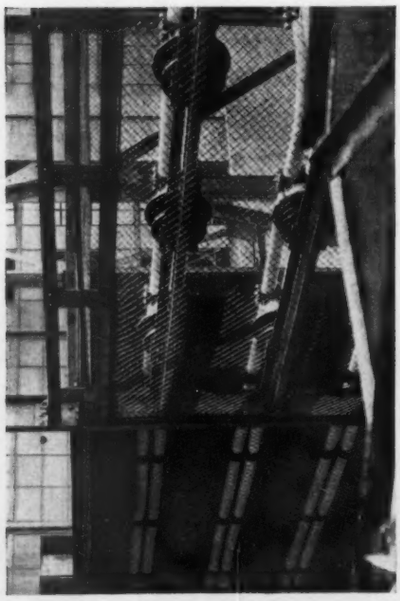


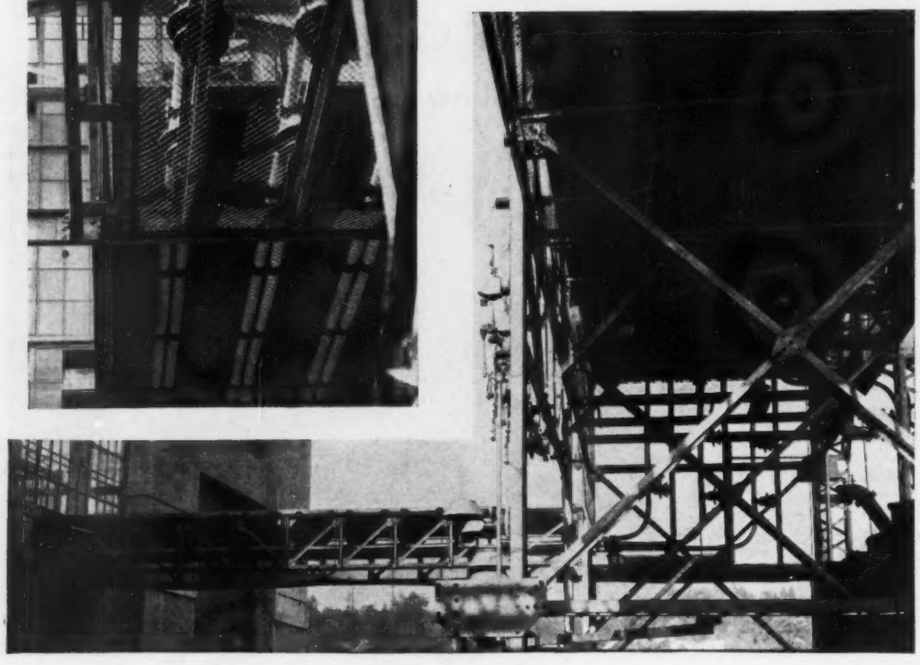
Breaker-Mounted "Disconnects" Save Space

Mounting of disconnecting switches directly on oil-circuit-breaker terminals is an important factor in the compact 12-kv. structures of the substations of the Commonwealth Edison Company, Chicago. The clips shown are used for ground connections. The hot clips, not shown, are mounted on the disconnecting - switch panel. All clips are of full floating construction, as are also the blade mountings, so that some flexibility is allowed in lining up the breaker setting.



Canopy Protects Open Generator Lead Run





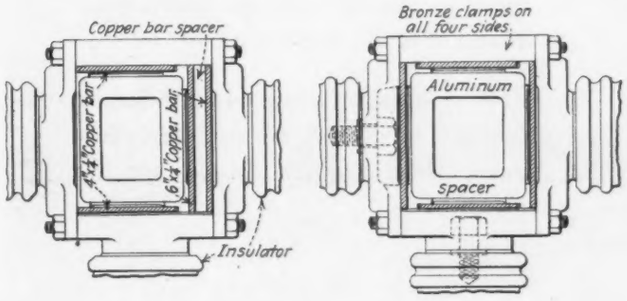
At the Shuffleton steam plant of the Puget Sound Power & Light Company the problem of handling the heavy 13,200-volt generator cables from machines to bus was solved by carrying them to the outdoor bus at terminal elevation under a concrete canopy. The outdoor low-tension bus was protected and screened in like manner as shown by one of the accom panying illustrations.

This method of bringing out the leads has the advantage of low cost, minimum length of leads and ready accessibility. At present the Shuffleton plant contains two 35,000-kv. generators. One is connected solidly to the outdoor bus, while on the other there is an oil circuit breaker located directly beneath the machine.

CONSTRUCTION IMPROVED

"Square" Bus Gives Rigidity with Ease of Assembly

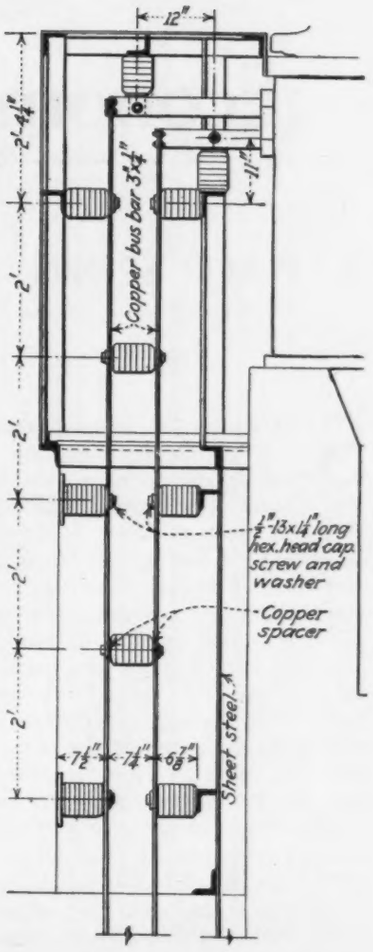
A four-bar "square" bus is used in the main generator leads in the James H. Reed station of the Duquesne Light Company at Brunot Island, Pittsburgh. This construction necessitates a special spacer and clamp assembly. The detail at the left of the



accompanying illustration shows the three-way support of the "A" phase, while that at the right shows the "B" phase. The "C" bus is the same as the "A" except that the double bar is on the other side. The spacer is an aluminum casting with an open web inside at one end for stiffening. This construction is very rigid and, having only four bolts, is easy to assemble.

Generator Lead Braced for Strength

Possibility of wider insulator spacing, with some consequent saving, is often encountered in heavy conductor installations where two bars are run in the same compartment. This is illustrated by the practice adopted for generator leads in the Shippingport plant of the Louisville Gas & Electric Company. Between the usual bus-type supports are insulator spacers that give a truss-like rigidity to the construction.

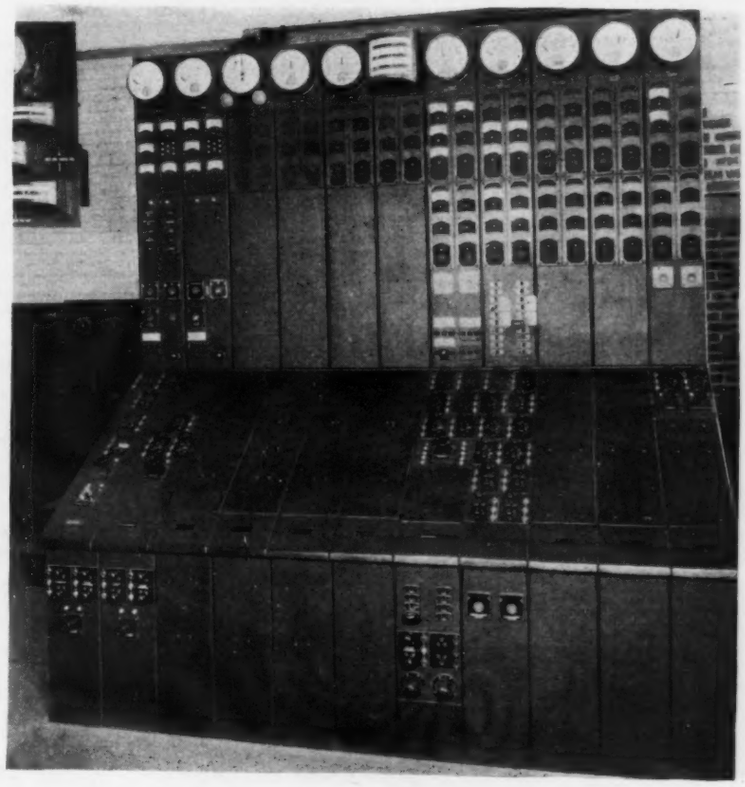


Compact Control Board Solves Space Problem

In extending the steam generating plant of the Lynn (Mass.) Gas & Electric Company it was necessary to provide a 13,800-volt control board in a restricted area in the switchboard room of the older section of the station. This board controls a 25,000-kva. generator and exciter, an 1,875-kva. auxiliary generator on the shaft of the main unit, with its exciter; bus tie and foreign tie switches, an emergency exciter, and twelve 13,800-volt feeders with spare panels for two future main generators, auxiliary generators and exciters. All told, there are eleven panels in the set-up, the control circuits being energized by 125-volt direct current.

The panel widths customary in control-board practice could not be used, and the designing engineers were obliged to confine themselves to a maximum of 8½ in., giving the board an over-all length of about 91 in. Instruments of correspondingly decreased diameter were provided, and the board was built to a height above the floor of 90 in., the width at the top being 24 in. and at the bottom 54 in. This required the installation of unusually condensed control wiring runs approaching the standards of practice established in communication engineering. The board occupies a floor area of only 34 sq.ft. and will care for the control of from 75,000 kva. to 125,000 kva. in main generating capacity if necessary.

The design was the joint work of the engineers of Stone & Webster Engineering Corporation, of the Lynn company and of the Philadelphia works of the General Electric Company.



Economical Protection of Terminal

By PHILIP SPORN

Electrical Engineer American Gas & Electric Company

IF ECONOMIES were disregarded, it might not be difficult so to install terminal equipment that it would be substantially lightning-proof. But the rub comes in figuring how to provide such protection without having to float a special bond issue.

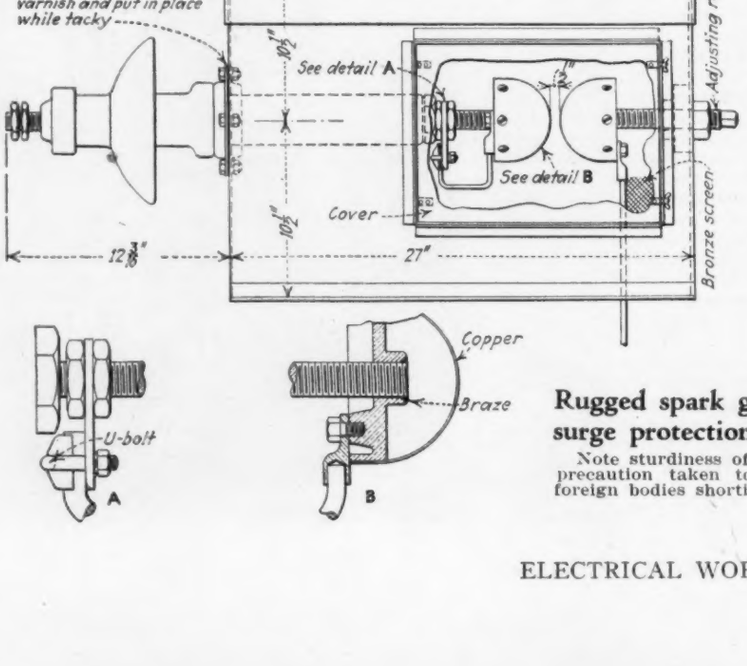
THE author compares different methods of protection and then illustrates their application to specific conditions.

SOME progress in the protection of terminal equipment against lightning has been made during the past decade owing to the better understanding of the forces that are encountered—their magnitude, behavior (such as extent of travel), and duration. This knowledge is incomplete, but it is so much more extensive than formerly that there is now no doubt that engineering and economic principles can be successfully applied to the solution of the problem.

As lately as four or five years ago there were roughly two schools of thought concerning protection—one believed in lightning arresters of the type current at the particular time and the other did not. Followers of the first school, if they specified the operating voltage and bought lightning arresters for that voltage, believed that they had done their duty, and that they were thus entitled to immunity from damage caused by lightning. Adherents of the second school believed that the arresters were useless and felt that apparatus, particularly if it came into the 132-220-kv. class, ought to be strong enough to resist any lightning voltage; therefore they did not propose to waste money on "foolish gadgets."

Today we know a little better. For example, we know roughly the possible order of magnitude of lightning voltages that may be impressed on station apparatus. We know that it would be utterly unreasonable to expect a winding to withstand such voltages. Roughly again, we know the relationship between power-frequency strength of most equipment and lightning strength. Thanks to the cathode-ray oscillograph, we know a little bit more about the performance of the lightning arrester. Stresses inside transformers and rotating machines are better known. In the former at least it is now possible to distribute the stresses more or less evenly along the whole length of the winding. Differentiation between steel and wooden construction has come about and we are now able to express the insulation of the latter in terms of a unit common to both. We can better evaluate the spark gap by itself and appreciate its benefits and limitations in conjunction with other apparatus such as a lightning arrester.

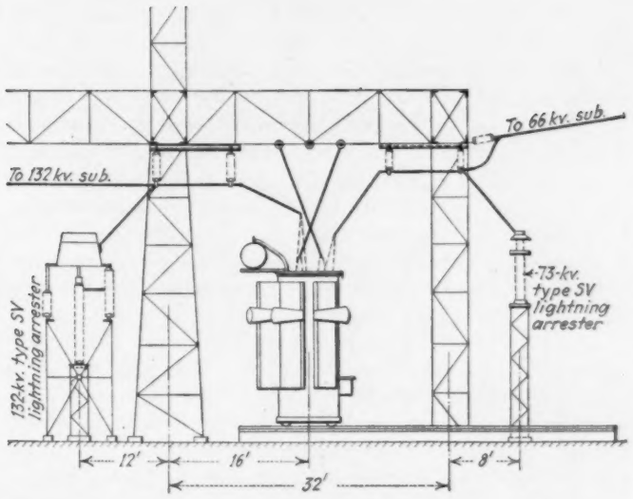
In short, we have acquired a fund of knowledge as to the behavior of lightning and some information regarding certain tools or means of combating it. Their selection and application to give maximum protection for a given expenditure, or to give a certain grade of protection for a minimum expenditure, is a problem in engineering economics. The arrangement of insulation levels of the various classes of apparatus to give maximum continuity of service and the confinement of breakdown, when it does occur at or near a station, to predetermined points, constitute what is known as rationalization of the station insulation.

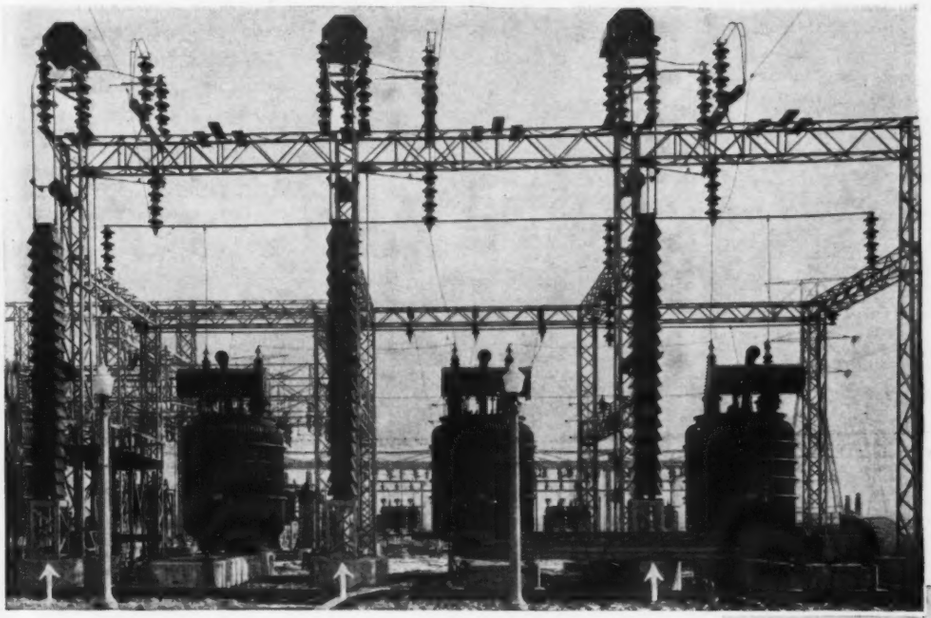


Rugged spark gap for lightning and surge protection of 11-kv. generator

Note sturdiness of current-carrying parts and precaution taken to prevent insects or other foreign bodies shorting the gap.

Equipment Against Lightning



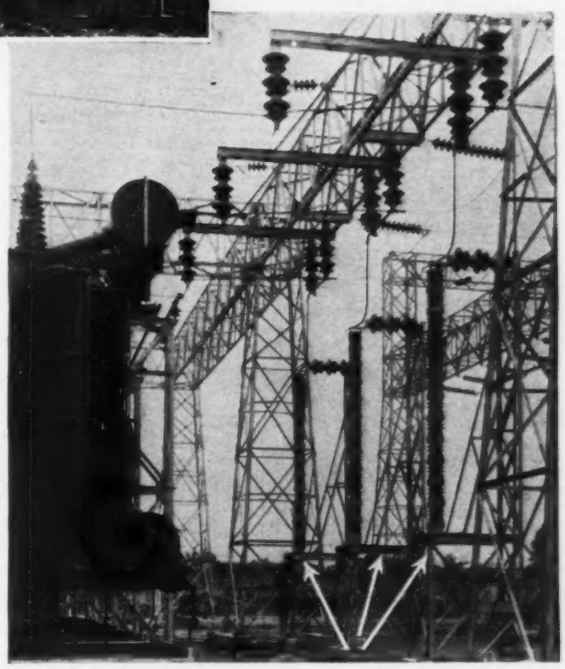


How arresters were placed close to transformers in three stations

Above — 132/66/132/11-kv. substation with 132-kv. auto-valve arresters.

In Center — 132-kv. single-stack oxide-film arresters.

Below — Installation of 132-kv. Thyrite arresters.



What are the tools of protection against lightning? When one gets down to enumerating them they are rather few. Briefly we have:

1. *The Spark Gap.*—This can take the form of a sphere gap, or of a horn gap, fused or unfused, or of an insulator having a body composed of a string of suspension insulators, a post insulator or a bushing. Obviously, if the sparkover value of the gap is definitely known and the gap is made to spill at a value lower than the lightning strength of the terminal apparatus, then the discharge of the gap will prevent the building up of a potential dangerous to the apparatus. This is the simplest and least expensive tool. When used care should be taken that the gap itself will handle the short-circuit current imposed on it until the breaker opens the circuit. An example of a gap that had to be specially designed for protection of an 11,000-volt generator because no standard gap available was capable of handling the dynamic current following the gap discharge is illustrated.

This form of protection, as with arresters, should be

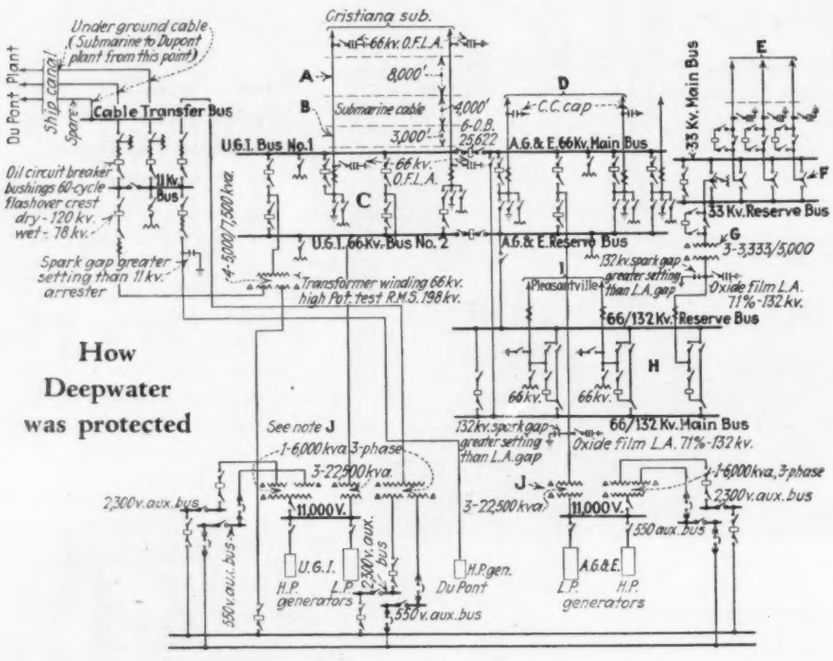
applied as closely as possible to the equipment to be protected; otherwise reflections of waves that go past the gap might damage the weak equipment. Under all conditions gap protection is open to the objection that it involves a circuit-breaker operation and therefore an interruption when it functions. This has sometimes been overcome by using two parallel gaps, one set lower than the other and fused. But even under these conditions both gaps will frequently discharge. In territory subject to frequent lightning disturbances this will occur often enough to make the rendering of continuous service very difficult.

2. *The Lightning Arrester.* — The term "lightning arrester" is, of course, a misnomer. Lightning arresters that will actually *arrest* lightning have been seriously considered and an arrangement for diverting direct strokes on a line is now under experimental observation. But the lightning arrester of commerce, as known today, is intended to pass lightning discharges of sufficient magnitude to lower the lightning potential to a degree where dynamic current will not follow. The stimulus that lightning-arrester development has received within the past three years as a result of special and general lightning researches leads the friends of the arrester to believe that it may be developed into as efficient a device as they had hoped it was.

Where the arrester can economically be justified two things should be remembered:

First, it is necessary to expose the lightning arrester to some danger. Since the justification of a lightning arrester is measured by its ability to protect a piece of apparatus, it should be so situated that this apparatus receives all the protection that the arrester can afford. If subjecting the arrester to the full brunt of a disturbance sometimes causes its failure, it is well to remember that the arrester was sacrificed in a good cause. So-called 100 per cent arresters have virtually no place on modern power systems.

Second, it is advisable to place the arrester as close as possible to the piece of apparatus it is particularly desired to protect. This reduces the possibility of waves building up between the arrester and the apparatus to be protected. Examples of ways in which close proximity are gained are illustrated.



A—Lines 40 ft. above ground; three ground wires per line.

B—Lines 60 ft. above ground except at canal crossing, where they are 100 ft. high; three ground wires per line.

C—Substation insulators—two 66-kv. Locke 7785; 60-cycle flashover crest, dry 370 kv., wet 268 kv.

D—66-kv. lines on steel towers; one ground wire per line except first mile, which will have two; insulators OB—25622—six units except on mile adjacent to substation, where five units; six units dead end on structure and first tower equipped with rings. Six units OB 25622—60-cycle flashover crest, dry 430 kv.; impulse crest—front 910 kv., tail 740 kv.; five units OB 25622—60-cycle flashover crest, dry 370 kv.; impulse crest—front 866 kv., tail 709 kv.

E—33-kv. lines; three units OB 25622 on wood poles; 60-cycle flashover crest, dry 245 kv., wet 183 kv.; impulse front of wave 470 kv., tail 400 kv.; dead end on substation structure—four units OB 25622, 60-cycle flashover crest, dry 310 kv., wet 230 kv.; impulse front 615 kv., tail 520 kv.

F—Switch and bus supports—one Locke 7785, 60-cycle flashover crest, dry 215 kv., wet 136 kv.

G—Transformer bushings—G E F-37-A, 60-cycle flashover crest, dry 217 kv., wet 168 kv.; transformer windings—33 kv. high potential test 70 kv. (r.m.s.), 66/132-kv. high potential test 265 kv. (r.m.s.).

H—Bus supports etc.—Four Locke 7785, 60-cycle flashover crest, dry 637 kv., wet 532 kv.

I—132-kv. lines operate at 66 kv.; steel towers, two ground wires per line, ending on tower adjacent to station; ten insulators on line in suspension; twelve dead-end, except at substation, where ten units; for 66-kv. operation first mile adjacent to substation to have five units.

J—Transformer bushings—Westinghouse, 60-cycle flashover crest, dry 539 kv., wet 462 kv.; 66/132-kv. windings high potential test 265 kv., induced voltage test 309 kv. (r.m.s.).

3. *Lightning-Arrester and Spark-Gap Combinations.*—If the lightning arrester will perform its job as it should, it ought to be possible to install it and a parallel gap close to the apparatus to be protected and obtain the benefits of each without the drawbacks usually attendant upon the spilling of a gap. In this combination the gap is available as a last line of defense, but the arrester is expected to do the work well enough to prevent the gap from spilling over. The existence of the two side by side, while difficult to reconcile offhand, nevertheless can be justified: if operation side by side discloses a failure of the gap to spark over under conditions when sufficiently high lightning voltages exist, it thus gives adequate proof as to the efficiency of the arrester. Experience along this line is greatly needed.

4. *Reduced Line Insulation.* — If the line insulation to earth is reduced for a sufficiently great distance from the terminal equipment — say from one-half mile to a mile—to render the insulation value less than that of the apparatus at the terminals, the latter will obviously be fairly well protected under virtually all conditions, since the line insulators will act as a spill gap. This method, therefore, has about all the good points and all the faults of the spark gap. It may involve the additional difficulty of inability to comply with code or other governmental specifications where

crossings over railroads are involved in this first half mile or so. Applied, however, with discretion, it does offer a means of bringing line insulation more within the range of the station apparatus level, leaving to some of the other devices the final job of co-ordination.

5. *Over-Insulation of Station Apparatus.*—This title is again not a very accurate description of what is done; however, the case is commonly referred to thus. What is really meant is the bringing up of the lightning insulation value of the station apparatus above what commonly exists—there being no standards—on apparatus of a particular voltage rating. This is perhaps the most expensive way of protecting terminal apparatus. On the other hand, in the absence of positive knowledge as to efficacy of lightning arresters, and agreeing that gaps, fused or otherwise, or reduced insulation are unthinkable because of the service angle, it is apparent that this form of protection may be the only one available to the station designer. Again, in certain classes of apparatus inherently weak from an insulation standpoint —such as potential transformers, metering equipment, etc.—this method of purchasing protection may be the most economical of all. Certainly, it is very often possible to take a given design of transformer, say, and push its insulation level 10 or 20 per cent above normal value and do so at a very moderate cost. Where the lightning strength of the transformer can be built up independent of the power frequency insulation strength, this may be particularly easy.

6. *Combination of the Above.*—The procedure outlined in the last paragraph may not yield a design completely self-protecting, but it often will give a design capable of being properly protected by means of some one, or a combination of a number, of the other methods described, without encountering the difficulties normally inherent in their independent application. In other words, by a study of all the devices or means available that most suitable to any situation can be selected without going beyond the prescribed economic limits.

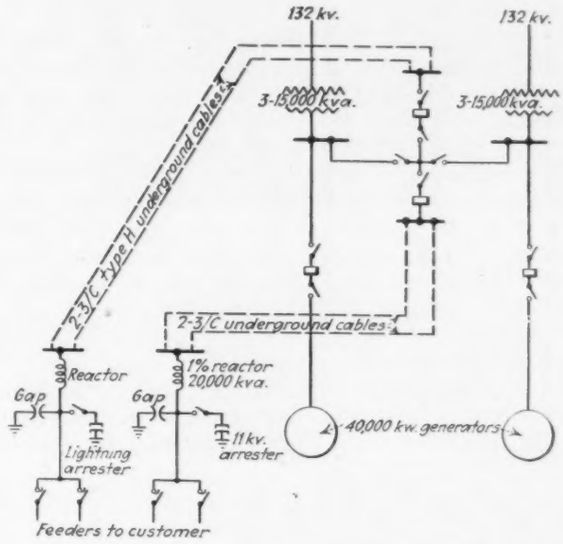
Practical application of protective methods

To show the practical development and application of the ideas outlined, a brief description of the scheme of protection adopted for the Deepwater plant recently placed in service will be outlined. The generators are rated at 11,000 volts, but energy is being distributed at 11,000, 33,000 and 66,000 volts, and one portion of the yard is insulated for 132,000 volts, although operating for the present at 66,000.

The main step-up transformers—two banks of three 22,500-kva. units each—were bought for series-parallel operation at 132 kv. and 66 kv. So far as insulation above ground was concerned the insulation was standard, but the coil-to-coil and turn-to-turn insulation was above normal (309 kv. test). By this modification it was felt that a better-balanced design would be obtained. The two transformer banks were built to the same specifications, but the transformer bank on the side destined for 132-kv. operation has a 71 per cent arrester with a parallel spark gap; the other bank is not equipped with a lightning arrester. Obviously it should need none.

One generator is connected through underground submarine cables to the 11,000-volt bus supplying 11-kv. overhead feeders. While it was believed that the exposure of these overhead lines would cause no trouble, the precaution of attaching a grounded spark gap at the terminals of the generator cables was taken. The particular gap has already been referred to and is illustrated in the line drawing that is shown on the first page of this article.

The 132-kv. bus insulation was made approximately 10 per cent higher than the oil-switch bushing flashover value. The potential transformers, bought for 66-kv. service, were built with 100-kv. insulation, the plan being



How reactors, gaps and arresters were used to protect circuits at Philo station

to replace them later. On the other hand, the current transformers were obtained with standard 132-kv. insulation. In the case of the potential transformers no fuses are employed, even where they are connected solidly to the bus. Insulation of the 132-kv. circuits to Pleasantville, normally equipped with twelve and ten units, was cut for a mile from the terminal to five units for the duration of 66-kv. operation.

The transformer bank feeding the 33-kv. bus was, because of its smaller importance, designed for standard insulation on the 132-kv. end, but again a combination arrester and spark gap was installed at the terminals. One of the accompanying views shows very clearly the compact single-stack designed and worked out for this arrester—an oxide-film type—and the closeness of spacing between it and the transformer. The 33-kv. bus fed by this bank was insulated to the practicable limit and the remainder was intrusted to standard three-legged 33-kv. arresters. The bushings on both the high and low sides were, of course, properly co-ordinated with the winding insulation.

The buses designed for permanent 66-kv. operation were chosen for the same flashover value as the oil-switch bushings. In doing so a considerably higher value of insulation was employed than is standard or current for this particular voltage. Insulation on the 66-kv. overhead lines consists of six units except for a mile outside the station, where it has been reduced to five units.

Between the 66-kv. bus and a switching station on the opposite side of the river are two circuits each consisting

of half a mile of overhead line, submarine cable and 1½ miles of overhead circuit in series. To protect the submarine cables 66-kv. lightning arresters were installed on the ends of each cable and the overhead portions of the circuits were amply surrounded by ground wires.

The transformer bank connecting the 11,000-volt bus with the 66,000-volt bus, consisting of three 5,000/7,500-kva. transformers, was built for 100-kv. insulation on the 66-kv. end. With this margin of safety no lightning arresters of any type were considered necessary.

It will be noted from the preceding that practically every form of protection available to the engineer was employed in the design of this particular station and that a determined attempt was made to have the choice reflect a sound engineering and economic balance.

From time to time there arise special problems in protection of terminal apparatus which appear difficult of solution, particularly if the expenditure that can be made is definitely limited. Typical of such special problems is the protection of large generators and rotating equipment from lightning voltages where this equipment is connected to buses feeding overhead circuits. Very often this difficulty is aggravated by the fact that in the original design no thought was ever given to the taking out of overhead circuits. The standard solution, calling for the insulation of insulating transformers or similar devices, might, of course, be employed; but it not only presents difficulties in the way of regulation but also involves heavy expenditures in capital costs and in losses.

Such a problem arose recently at the Philo plant, where all transmission was originally planned to be at 132,000 volts. However, a need arose for supplying some local load at 11,000 volts, and the feeders, for economic reasons, had to be run overhead. The problem of protecting two 40,000-kw. generators from lightning was solved by inserting a 1 per cent 20,000-kva. outdoor reactor between the overhead lines and the cables which connected to a spur bus from the main generators. A lightning arrester on the line side of the reactor, together with a sphere gap set at ½ in. (the same design discussed before and illustrated), was installed on the generator side of the reactor. In the past two years this combination has functioned a number of times under lightning and other disturbances without any apparent damage to the generators.

The principles and ideas employed were feasible in this case because the type of load served could stand a short interruption upon the functioning of the protective equipment. On the other hand, it was because the load was of such a type that so little could be justified for protection expenditures. This, again, brings forcibly forth the economic aspect of terminal protection against lightning.

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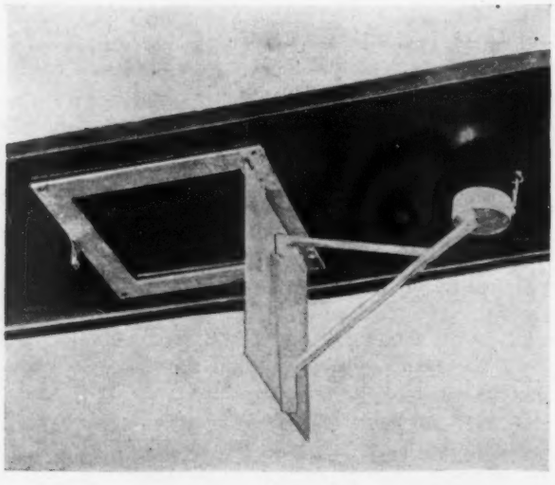
Fusible Link Controls Transformer Vault Ventilation



To cut off air circulation in transformer vaults in case of extreme temperature rise due to fire or when smothering is required the Fall River Electric Light Company utilizes dampers controlled by fusible links and actuated by a counterweight arrangement as illustrated. In the horizontal type damper a counterweight is supported at the end of a bracket arm and hooked into a panel above by a link, the other end of the bracket arm being fastened to the cover. When the link melts the cover is automatically thrown into the closed position by the falling of the counter-weighted arm, and remains closed by a catch until released by hand. Vertical damper covers are normally held open by the fused link and are closed by their own weight when the link melts.

Single Point Grounding Eliminates Cable Sheath Currents

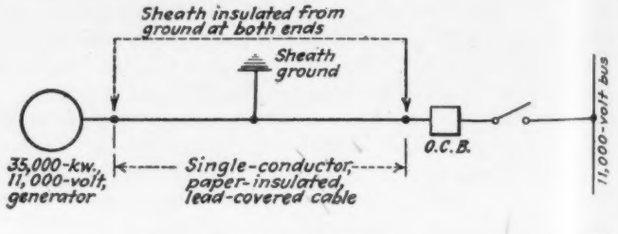
In connection with its 1930 construction program the Pacific Northwest Public Service Company, Portland, Ore., has installed 13,430 ft. of 1,500,000-circ.mil, 11,000-volt, single-phase lead-covered cable for generator leads, transformer leads and bus-tie connections. With the lead sheaths grounded at both ends the sheath current would amount to approximately 37 per cent of the

CONTINUED PROGRESS

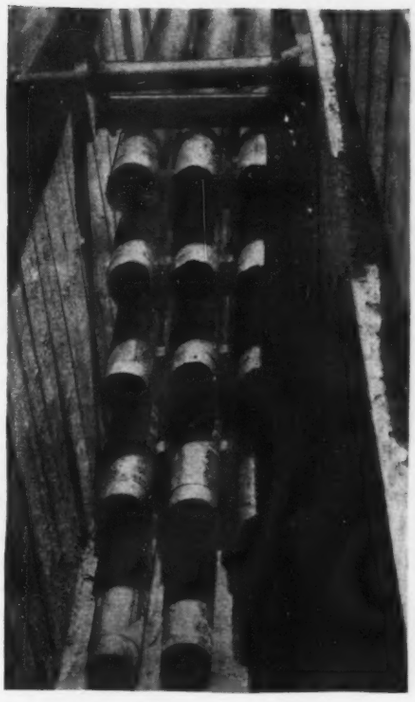
conductor current and the sheath loss to about 200 per cent of the copper loss.

Sheath losses have been eliminated in these installations by grounding the sheaths at only one point. In most cases this is near the middle of the cable length. The sheath currents are prevented from flowing by insulating the cable terminals from ground. A typical method of grounding is shown by the accompanying sketch. Since the longest cable is only 360 ft. and the induced voltage but 4 volts per 100 ft., it follows that the maximum induced voltage from midpoint to ungrounded end is only about 7 volts.

This method of installing single-conductor, lead-covered, paper-insulated cable results in a large saving as compared with the alternatives of accepting the sheath losses or installing non-leaded conductors of the same operating voltage.



Underground Service Ducts Concreted Within Piling



In making the change-over from overhead to underground service in the business section of Mobile, Ala., for the Alabama Power Company, Allied Engineers, Inc., overcame several difficulties which arose there. Mobile, like some other Southern Cities, is only a few feet above sea level and basements are seldom found.

To prevent cave-ins of the soft ground, wooden-plank piling

was driven and braced along the excavation. This remained in place until the concrete surrounding the multiple-fiber conduit was poured, after which the piling was pulled. An ingenious bracing device for manhole construction, and one which saved both carpenter work and time, consisted of angles bolted together around the inside of the piling. The piling served as the outside form, and as the concrete was poured for an 8-in. wall, these angles were slipped up.

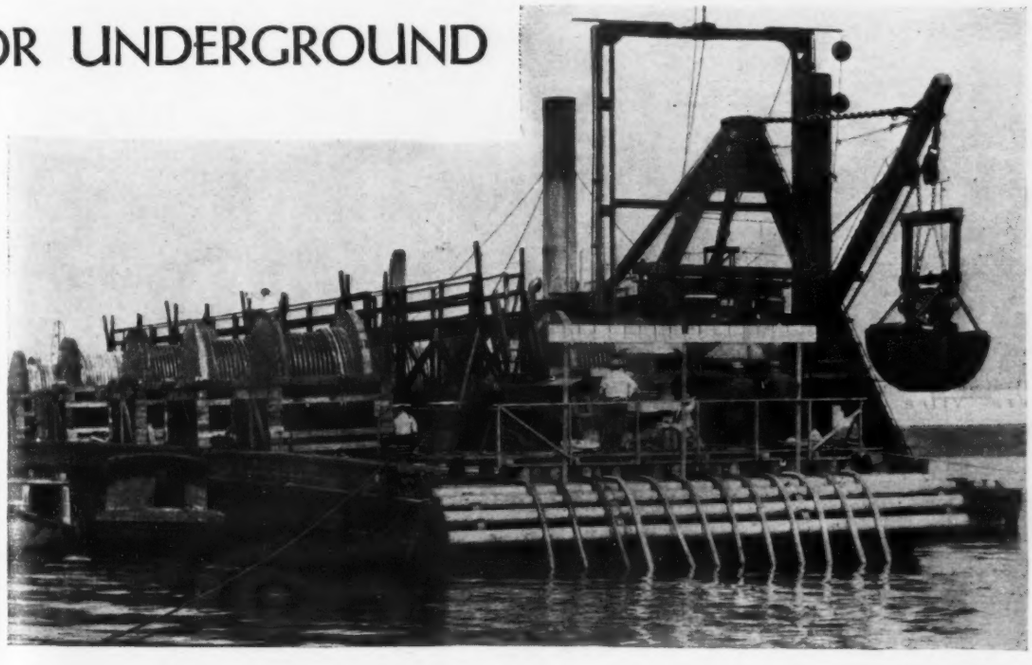
Twelve 35-Kv. Cables Simultaneously Installed

Careful planning for the laying of twelve 35-kv., 350,000-circ. mil, three-conductor type H cables simultaneously in the Patapsco River was brought to a successful conclusion recently by the engineering staff of the Consolidated Gas, Electric Light & Power Company of Baltimore.

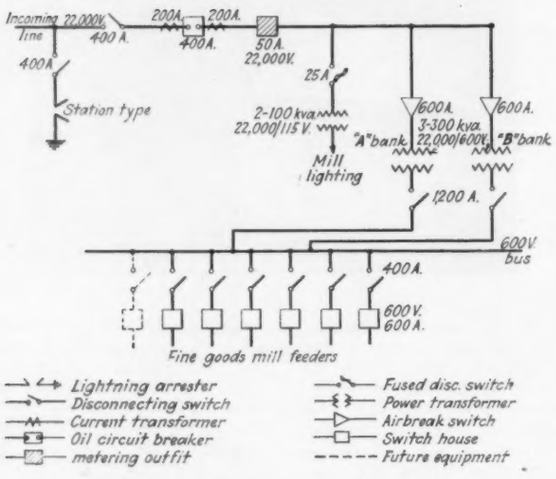
Cable reels, sighting boards and paying-off equipment were mounted on a car float which was pulled across the river by a dredge. In laying the cable a trench 30 ft. wide was dredged to a depth of 47 ft., about 100,000 cu.yd. of material being removed for the 2,100-ft. lengths.

The twelve reels of cable, each weighing about 32 tons, were arranged so that cables were laid about 2 ft. apart. Backfilling of the trench to a depth of 5 to 7 ft. required about 25,000 cu.yd. of material. The actual laying required the car float, dredge, one tug to shift anchors and two tugs for warning river traffic.

FOR UNDERGROUND



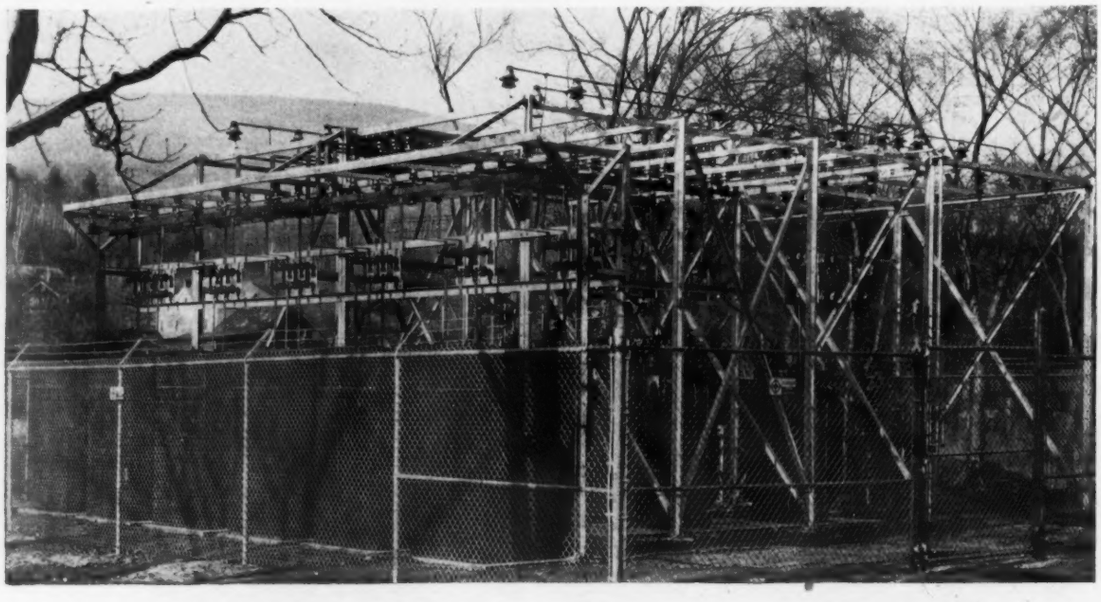
Electrify Textile Mills for Efficient Production



Reliability of power supply essential

Continuity of service is insured for the textile mill by a simple wiring layout and the installation of two banks of power transformers energized from an important urban substation.

WHEN a manufacturing organization of financial resources, administrative skill and engineering insight acquires control of mill properties favorably situated with regard to economic production and susceptible to modernization, something interesting is apt to happen to the plant facilities before many months elapse. If such mills are accessible to purchased power on favorable terms, negotiations leading to the use of such power are likely to come to a head very rapidly, and soon a comprehensive program of betterment becomes a reality. Such has been the recent experience of the Greylock divisions "A" and "B" of the Berkshire Fine Spinning Associates, Inc., at North Adams and Williamstown, Mass., producer of fine cotton cloth and yarn. In the full face of severe depression in the textile industry, the men behind this organization have gone forward and electrified these mills in the firm belief that the economies of such a course, combined with the savings from purchased power, will aid the properties to compete with others and measure up favorably with mills located elsewhere under the same management. The results have been most gratifying, judging them by the so-called "Berkshire unit" of comparison, which gives mill "A" an index figure of 1.15 per month compared with the somewhat less efficient indices of 1.35 and 1.27 per month for two other mills ("X" and "Y") of the organization producing the same type of goods.



Oil breakers used only in 22-kv. line and 600-volt mill feeders

Power transformers can be isolated by air break and disconnecting switches on primary and secondary sides respectively. Auxiliary buses were omitted in the interest of simplicity and minimum first cost.

By F. S. ROOT and
C. D. LAWRENCE

New England Power Association, Boston, Mass.

Innumerable old textile mills can be electrified economically

In the early days of textile mill electrification representatives of the New England Power Company negotiated with the then owners of Greylock Mills in North Adams and Williamstown for the sale of power. Although those in the electrical industry even then firmly believed in the economies resulting from electrification and purchased power, it was more difficult then than now to convince mill owners of the fact, and the negotiations were not successful.

The problem of selling power to the Greylock Mills was complicated by the existence of a considerable amount of flashy water power, making the steam load which purchased power would replace extremely variable, for at times more water power was available than could be utilized and at other times the load had to be carried almost entirely by steam.

Negotiations were kept active in spite of this early lack of success and of the post-war depression in the textile business. Conditions from the power salesman's point of view were much improved in 1928, when spring floods took out the impounding dam and eliminated the water power available at Greylock mill "B," making it necessary to carry the entire load at this mill by the existing steam plant.

There still were, however, many obstacles to overcome, for with the reduction in water power available had come at the same time a further textile depression which made the investment required to electrify the mills (which were mechanically driven) of major importance.

Late in 1928 the Berkshire Fine Spinning Associates, Inc., was formed and took over the Greylock Mill group, along with several other mills. This changed the situation very much, since the new organization not only had greater financial resources but was a firm believer in the economies to be secured through electrification of mechanically driven mills. Negotiations were reopened in January, 1929, and were successfully consummated with the signing of a contract for the purchase of power.

The first step in these negotiations was the preparation of a comparative report of purchased power versus private plant costs, which conclusively proved a sufficiently satisfactory saving in operating costs by purchasing power to justify the required investment. Basing its conclusions on this report and its own observation in its other plants which were already purchasing power

PROGRESSIVE methods are imperative in industries laboring to overcome the handicaps of depression.

THE example of New England textile mill electrification discussed here shows the value of systematic study of obstacles to the economical equipment and operation of an established plant by purchased power.

CONSTRUCTION procedure followed by the power company, client and electrical manufacturer chiefly concerned reveals a plan of action which evidently worked well from the co-operative standpoint.

EMPLOYMENT of an unusual unit of mill performance involving manufactured output and electrical energy consumption suggests the desirability of developing similar yardsticks of plant efficiency in other industries.

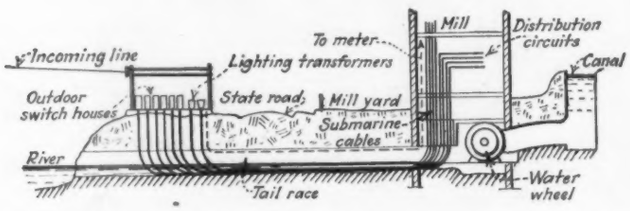
from the New England Power Association, the management decided to proceed with the electrification.

As a preliminary measure, an informal agreement was drawn by Greylock divisions "A" and "B," the General Electric Company and the New England Power Company briefly outlining the division of labor on the construction plans and installation work. This agreement provided a definite boundary between the work of each party and proved to be of great value to the engineers of all three companies.

Investment saved by using lightly loaded line

The New England Power Company could not serve Greylock divisions A and B from any of its existing transmission lines without a considerable construction of additional lines through fairly congested territory.

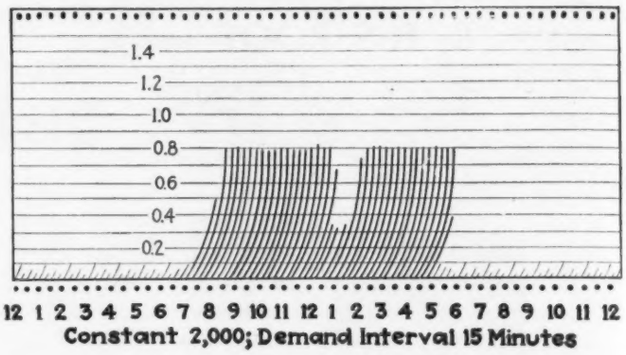
The Adams substation, an installation of major importance having three independent sources of supply and adequate capacity to carry this additional load at 22,000 volts, was 9 miles away, and in order to provide good



Old tailrace used as channel for submarine cable connections to outdoor substation

service it would be necessary to construct a two-circuit line from this point to the Greylock Mills over quite congested territory where a right-of-way would be difficult to obtain.

The North Adams Gas Light Company has a 22,000-volt line supplied from the New England Power Company's Adams substation and running with two circuits on separate pole lines to its Brown Street substation in North Adams and thence with one circuit to Williamstown. That part of this line running from North Adams to Williamstown passes within a half mile of the Greylock Mills.



Steadiness of load during daylight running hours characterizes the fine goods mill

Consultation with the North Adams company revealed that this line from the power company's Adams substation had been constructed to care for the North Adams and Williamstown loads of the North Adams company for some years to come and was as yet quite lightly loaded. Detailed study showed that, without unforeseen contingencies, there would be sufficient unused capacity in this line to carry the Greylock load for about ten years and that an additional circuit could be added on available pole space should future load requirements make more capacity necessary.

It appeared to be good economics to utilize the existing investment so far as possible, hence an arrangement was made with the North Adams company by which it would carry the Greylock load on its existing circuit and over two new tap lines, one to each of the Greylock mills "A" and "B." Since the North Adams company purchases its energy from the New England Power Company at the Adams substation, the electricity taken by the Greylock Mills, plus transmission losses of the Greylock Mills load superimposed on the North Adams company's load, is deducted each month from the total

AGREEMENT AS TO CONSTRUCTION DETAILS FOR ELECTRICAL EQUIPMENT

In conformance with agreement reached by the Greylock divisions "A" and "B," the General Electric Company and the New England Power Company relative to the purchase, engineering and installation of the electrical equipment for Greylock mills "A" and "B" the following procedure is mutually agreed upon and will be effective:

A. The General Electric Company shall do the following:

1. Select the proper sizes and types of motors.
2. Locate them (approximately).
3. Supply the engineering plans and specifications for caring for the lighting requirements, for the secondary buses, circuits and switching equipment, and building requirements for housing same if needed.
4. Provide such engineering consultation and advice as may be required.

B. The Greylock Divisions "A" and "B," shall do the following:

1. Provide a suitable site for the substations.
2. Provide substation foundations.
3. Provide substation buildings (if any are required).
4. Provide necessary rights for secondary circuits where located under or over streets and railways (if necessary).
5. Mount and line the several motors as selected and located by the General Electric Company.
6. Put on belts, make shafting changes and do all mill work necessary in connecting motors to load.
7. Supply labor on any work that would be economically desirable.

C. The New England Power Company shall do, or cause to be done, the following:

1. Provide the engineering for the substations.
2. Provide foundation plans for substation and equipment.
3. Purchase and install the high-tension transformers and high-tension equipment for the complete substations.
4. Purchase from the General Electric Company motors, starting switches and necessary materials for the secondary buses, feeders, switching equipment and mill wiring as per plans provided by the General Electric Company and install same.
5. Mount compensators and magnetic switches.
6. Oil and connect up the motors ready for starting.
7. Provide engineering supervision for such labor as is furnished by the Greylock mills.

taken by the North Adams company in order to determine its purchase for its own load requirements.

By this arrangement the North Adams company was aided in carrying its own investment against its future requirements and duplicate investment in lines was avoided.

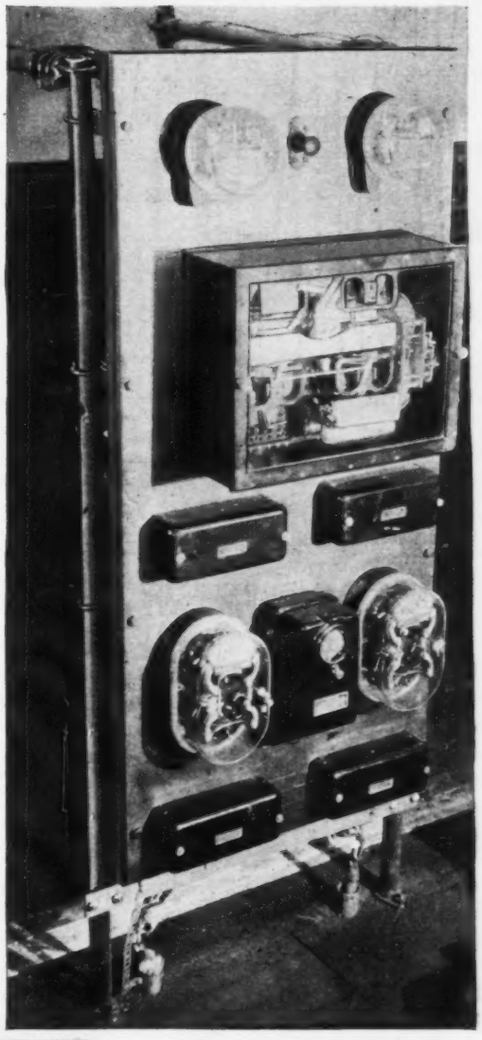
Substation and Outdoor Equipment, Greylock Divisions

Mill "A"

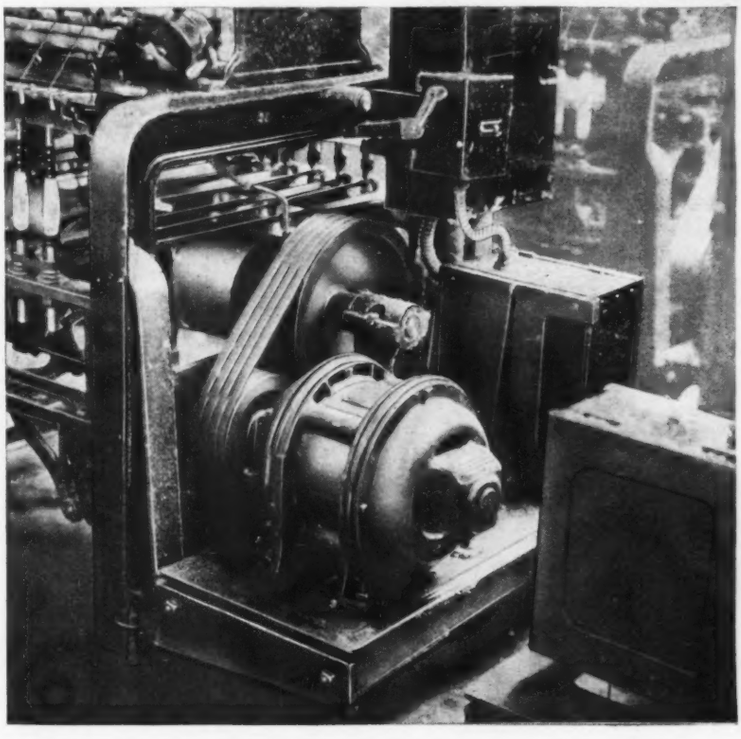
1. Lightning arrester—Westinghouse style SV, three phase.
2. Lightning arrester disconnecting switch—R. & I. E. type DVH-3, 15 kv., 400 amp.
3. Main disconnecting switch—R. & I. E. type DVH-3, 15 kv., 400 amp.
4. Main oil breaker—G. E. type FKO-136-1328 AS,-three pole, single throw, 25 kv., 400 amp., manual closing, electrical trip, capable of interrupting 2,300 amp. at 25,000 volts.
5. Metering outfit—Westinghouse, 22 kv. 50/100: 5 amp., three phase, three wire, 60 cycle.
6. Primary disconnecting switch, lighting tap—R. & I. E. type FD-VH-3, 15 kv., 25 amp., fused with Schweitzer-Conrad 15-kv., 25-amp. fuse.
7. Lighting transformers — two G. E. 100-kva., single phase, 60 cycle, 22,000/115/230 volts.
8. Air break switches, main service—two R.& I.E. type TTL-3, 15 kv. 600 amp.
9. Main transformers, two banks each—three G. E. 300 kva., type H-60, 22,000/575 volts with four 2½ per cent high-voltage taps.
10. Secondary disconnecting switches—two R. & I. E. 7,500 volt, 1,200 amp.
11. Outdoor switch houses—six G. E. type GB-5, each containing G. E. type IA201 relays, G. E. current transformers type WC-12-400/5 amp. and G. E. oil circuit breakers type FK-35, 7,500 volt, 400 amp., three phase.
12. Mill feeder disconnects—six R. & I. E. 7,500 volt, 400 amp.
13. Mill feeders—each consists of three-conductor, 400,000-circ.mil submarine cable with 2,500-volt varnished cambric insulation and lead sheath, jute and galvanized wire armor finish. These cables run through an old tailrace.

The loads at mills "A" and "B" were estimated to be 1,800 kva. and 700 kva. respectively. Since for the sake of interchangeability it was desired to have, if possible, all transformers at mills "A" and "B" of the same size, it was decided to install six 22,000/600-volt, 300-kva. transformers at mill A and three 22,000/600-volt, 300-kva. transformers at mill B. To permit shutting down the main power transformers, 22,000/110-volt lighting transformers were decided upon, two 100-kva. being used at mill "A" and one 50-kva. being used at mill "B." Since measurements were at primary voltage, this latter arrangement introduced no metering complication.

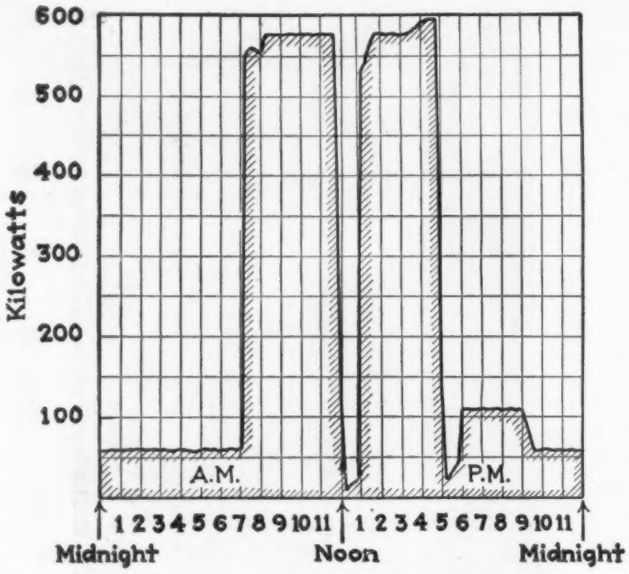
Due to the arrangement with the



Energy consumption and periodic demand in kw. and kva. are measured on this special panel



Close-up of Texrope drive on individually motored ring spinning frame where space is at a premium



Load curve of yarn mill for 24-hour run

North Adams company, it was necessary to obtain kilovolt-ampere as well as kilowatt demands of both mills. A chart showing the demands as established at mill "A" on April 17, 1930 (a typical day), is shown. Steady demand and remarkably high power factor are features of this load. A daily load curve for mill B is also shown, though part of the load was not thrown on until an hour after starting time.

For flexibility and economy, the mill feeders were taken directly off the 600-volt bus and run through disconnecting switches and outdoor steel switch houses to the mill. This plan made distributing switchboards within the mills unnecessary.

In the case of mill "A," no suitable location for a substation to supply the mill could be found on the same side of the road as the mill. Since the line supplying the mill was to come from across the road, and an overhead road crossing at this point would be undesirable, the unusual procedure was adopted of locating the substation and switch houses on the side of the road opposite the mill and running the mill feeders under the road through the tailrace of the hydro plant.

So as to co-ordinate the various individual activities involved in the design and construction, the job was scheduled step by step on a time basis, dovetailing the work so as to avoid delay and consequent lost time and expense.

Construction charts to sales department

Each week during the construction period a progress chart was made showing the work as scheduled and the amount completed both to date and during the week just terminated. Copies of those progress charts (as pictured) were sent to all interested parties, including the sales department, so that proper liaison in this respect was maintained and the sales department was constantly in the fortunate position of being able to answer immediately questions as to progress.

The Hoosac River, which runs past mills "A" and "B," became extremely low in the fall of 1929. At mill "B" the condensing water for the engine was drawn

Motor Groups, Greylock Division "B"

Motor Size, Hp.	Motor R.P.M	Driven Load
40	900	1 Waste machine.
		2 Finisher pickers.
		2 Breaker pickers.
		1 No. 6 fan.
30	1,200	15 Cards.
		96 Deliveries of drawing.
30	900	23 Cards.
		96 Deliveries of drawing.
30	1,200	1,892 Spindles of speeders.
2–30	900	18 Fly frames, 168 spindles each.
		4 Intermediates, 114 spindles each.
1–20	1,200	4 Spools, 100 spindles each.
		14 High-speed warpers.
1–75, 1–60	900	2,546 Spindles, 8-in. bobbin, 7¼-in. ring, four and five ply.
60	900	4,416 Spindles, 2-in. ring, 9,000 r.p.m., filling 800 spools.
50	900	12,576 Spindles, 1¾-in. ring, 9,000 r.p.m.
10	1,200	Carpenter shop.
7½	1,200	Elevator.
20	1,200	Pump.

Total horsepower, eighteen motors.....702½.

Motor Groups, Greylock Division "A"

Picker and Card Rooms

Motor Size, Hp.	Motor Speed	Driven Load
30	1,200	1 No. 6 blower, 1 H.E.B. bale breaker.
		1 Murray opener, 1 vertical opener, 1 condenser.
5	1,800	1 Finisher picker.
5	1,800	1 Finisher picker.
5	1,800	1 Finisher picker.
7½	1,800	1 Breaker picker.
7½	1,800	1 Breaker picker.
2–50	900	89 Cards, 4 ribbon lappers, 4 sliver lappers.
20	1,200	Card-stripping system.
40	900	32 Combers.
40	900	2 First intermediates, 104 spindles each.
		1 Slubber, 92 spindles.
		6 Second intermediates, 168 spindles each.
		8 Jacks, 200 spindles each.
50	900	56 Del. of drawing, 1 slubber, 96 spindles.
		3 First intermediates, 104 spindles each.
		1 Second intermediate, 168 spindles
		10 Jacks, 200 spindles each.
60	900	20 Jacks, 192 spindles each.
		4 Second intermediates, 168 spindles each.
20	1,200	8 Jacks, 192 spindles each.

Total horsepower, fourteen motors.....390.

Spinning-Weaving and Warping

Motor Size, Hp.	Motor Speed	Driven Load
3–75	900	Miscellaneous mule and ring spinning.
15	1,200	4 Spinning frames, 192 spindles each.
60	900	16 Spinning frames totaling 3,872 spindles.
60	900	16 Spinning frames totaling 4,064 spindles.
30	1,200	8 Spinning frames, 256 spindles each.
2–75	900	39 Spinning frames, totaling 9,210 spindles.
2–40	400	20 Spinning frames, totaling 4,928 spindles.
40	900	8 Spinning frames, 256 spindles each.
21–5	1,800	Each motor driving a 256-spindle frame.
2–75	900	32 Spinning frames, 336 spindles each.
5	1,200	3 Spoolers, 200 spindles each.
15	1,200	14 Warpers and 8 spoolers (940 spools)
8–50	900	1,171 Looms.

Total horsepower, 45 motors.....1,335

Miscellaneous Motors

20	900	Cloth room.
20	900	3 Slashers and kettles.
2–5	1,200	Each driving a freight elevator.
10	1,200	Machine shop tools.
10	1,200	Carpenter shop tools.
50	....	Humidifying system.
20	....	Humidifying system.

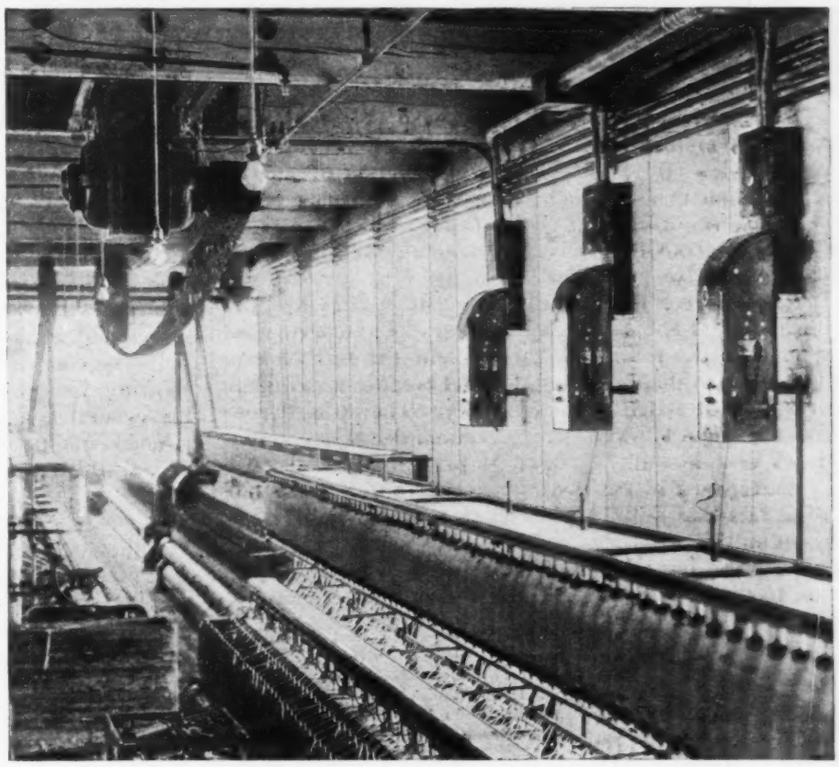
Total horsepower, eight motors.....140.

directly from the river, and so low did the river level go that as a desperate expedient a crude diversion dam of sandbags was used to guide all water possible to the condenser intake pipe. While this was fairly successful, the lack of sufficient condensing water became so serious that a special effort was made to hurry the electrification at mill "B." In October the water available for condensing purposes became entirely inadequate and the engine, running on low vacuum, was unable to carry the load, but electrification had fortunately progressed to the point where a temporary connection could be made and little or no production was lost at the mill. In December part of the load at mill "A" was connected and it was running fully electrified by January 1, 1930.

The boiler plant at mill "B" is now operating in the heating season only at low pressure for building heating alone, while the engine at this mill is in the process of demolition, since the trend toward purchased power has reduced the market for used steam engines to negligible proportions.

At mill "A," on account of the need of steam throughout the year for both slashing and building heating, the boiler plant is still operating, though under reduced pressure. It is hoped that an alternative method to the use of steam from the boiler plant for slashing will be found so that the boiler plant at mill "A" may also be entirely shut down except during the winter months.

At mill "A" it will be necessary ultimately to install an electric fire pump, though none will be required at mill "B," as two different sources of high-pressure water service are available. In this connection it is interesting to note that service to the fire pump will be looped in from one of the mill feeders and will be run along the edge of the basement wall and near the floor so that in case of fire and falling débris from floors above there will be much less danger of interrupting fire pump service.



Conduit and wire outlays kept down by mounting compensators on wall

Selection of motor drives

In selecting the type of drive to be used in mills "A" and "B" consideration was given to the fact that the existing shafting was generally in fine condition, in good alignment and with well-proportioned driving ratios. This enabled all unnecessary refinements in motor applications to be avoided, eliminating much installation expense.

As a result of this policy, a mixture of group and individual drive was adopted, with group drive predominating. In the picker room those machines which could be grouped together with a small amount of shafting were driven from one motor. Other machines, where the shafting arrangement was less favorable, were individualized.

In the card rooms group drives were used throughout, though mule pulley drives, where they existed, were eliminated by the proper grouping of machines. Vertical drives between floors were of course dispensed with.

In the spinning rooms group drive was also generally used, though where the belt centers were too short individual motors, with "Texrope" drive, were employed.

Elevators, of course, had their own motors, as did the carpenter and machine shops and the humidifying systems.

Wherever possible starting compensators were mounted on walls, high enough so as not to interfere with the free passage of employees or work trucks. All power circuits were run in metal conduit, ample capacity for possible future growth of load being provided.

With the exception of the motors for the weave sheds, which were located on concrete pads on the ground below the weave room floor, since line shafts were also so located, and looms driven from below, all motors were hung inverted from the ceiling on steel channels.

All motor hanging, shafting and pulley changes, belting, etc., was done by the plants' own millwrights, and belt centers were kept unusually long so as to allow the use of very slack belts.

Pulley sizes were computed to give the driven machines the highest speed consistent with good operating practice, keeping production at a maximum. Machines were carefully grouped so that all motors were fully loaded, thus not only minimizing the cost of motors required to operate the mill but also giving a good power factor. That both of these objectives were attained was found later in motor load tests and in power-factor indications. The power factor of about 85 per cent which

was attained at both mills is remarkable when it is considered that no synchronous motors or other power-factor-corrective devices are installed.

As a number of years had passed since the lighting equipment at both mills "A" and "B" had been installed, it naturally was far from modern, and was also badly in need of repairs.

It was therefore decided by the mill management that the time was ripe for a complete rejuvenation of the lighting equipment. Accordingly a clean sweep was made of all existing wiring and fixtures and an entirely new installation, along the usual modern industrial lighting lines, was installed.

Lighting transformer capacity of 200 kva. is provided at mill "A" and 50 at mill "B."

Actual operating results

The results obtained to date from all points of view have been eminently satisfactory. From an electrical point of view, the value of careful selection of motors with relation to loads to be carried is admirably borne out by the resulting high power factor, which runs consistently at about 85 per cent without the aid of power-factor corrective apparatus.

The connected load at mill "B" is now 702½ hp. and at mill "A" 1,865 hp. This latter ratio has been used rather than the ratio of kilowatt input (at full load on all motors) to the maximum demand because no estimate is required of actual motor efficiency. The ratio of connected load (in kilowatts) to maximum demand averages 80 per cent in mill "B" and 94 per cent in mill "A," the discrepancy in the two figures, of course, being due to the fact that mill "A" is a cloth mill and mill "B" is a yarn mill.

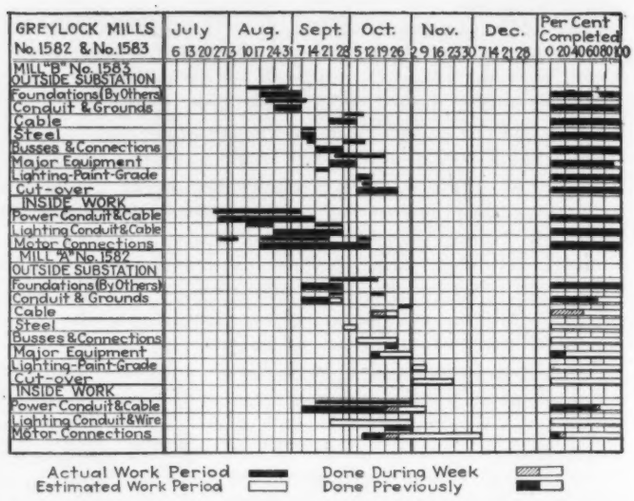
The following tabulation indicates the electrical operation to date:

Month	Kw.-Hr.	Max. 15-Min. Demand, Kw.	Ratio Connected Load to Max. Demand	Monthly Hours Use	Max. 15-Min. Demand, Kva.	Power Factor, Per Cent
Mill "B" (25,000 Spindles)						
Oct.....	67,032	595	0.88	113	708	84.2
Nov.....	112,161	666	0.79	169	768	86.7
Dec.....	102,679	672	0.78	153	780	86.2
Jan.....	125,244	706	0.74	178	840	84.0
Feb.....	125,832	650	0.80	194	774	84.0
March.*..	69,972	670	0.78	104	798	84.0
April*....	92,700	616	0.85	151	724	85.1
Mill "A" (66,000 Spindles)						
Dec..	66,640	660	Part load	101	804	82.0
Jan.....	228,340	1,300	Part load	176	1,512	86.0
Feb.....	285,180	1,604	0.89	178	1,864	86.1
March...	307,720	1,512	0.94	203	1,820	83.2
April.....	274,000	1,444	0.99	190	1,720	84.1

*Partial operation.

As a check on the efficiency of the motor installation, the accompanying comparison was made of the electricity used and amount of goods turned out at Greylock mill "A" with other fine goods mills owned by the Berkshire Fine Spinning Associates and operating on purchased power.

Since the mills compared in this table, although making the same type of goods, manufacture material of somewhat differing weights and widths, it was necessary, in order to make a fair comparison, to evolve a unit which tended to equalize these variables. The unit used, which for purposes of brevity we have called the "Berkshire unit," consists of the multiplication of



Letter-sized electrical construction progress charts were distributed weekly

kilowatt-hours per yard by kilowatt-hours per pound. This unit, which in the authors' experience is new, allows a fair comparison between mills as to the use of power and is simple in derivation.

In the comparison, mill "A" makes a very creditable showing, indicating that motor loading and grouping and the general layout of the electrification are as good as, if not better than, that of the other mills of this organization which were electrified in past years.

Advantages of electrification

Although electrification of textile mills with purchased power is not at all uncommon and has proceeded in the past very rapidly, probably each example has points differing from the usual and the Greylock Mills have not been an exception in this respect.

The economies of electrification of textile mills and the use therein of purchased power are almost always considerably greater than a mere comparison of the power

Comparison of Output, Consumption, Etc., on Monthly Basis

Items	Greylock "A" Mass.	Mill "X"	Mill "Y"
Number of cards	89	77	72
Total number of looms	1,185	1,262	1,551
Number of automatic looms	76	31	224
Percentage of automatic to total looms, per cent.	6½	2½	14½
Number of ring spindles	43,072	31,744	47,952
Number of mule spindles	22,760	30,240	19,056
Total number of spindles (ring plus mule)	65,832	61,984	67,008
Percentage of ring to total spindles, per cent	65	51	71
Pounds of goods manufactured per month	104,173	109,106	118,766
Yards of goods manufactured per month	789,871	736,117	898,340
Million "yard-pound" goods manufactured per month	82,283	80,314	106,692
Pounds of goods per month per loom	88	86	77
Yards of goods per month per loom	667	583	579
Yard-pounds of goods per month per loom	58,696	50,138	44,583
Total kilowatt-hours used per month	307,700	329,350	366,500
Kilowatt-hours used per month per yards of goods	0.39	0.45	0.41
Kilowatt-hours used per month per pound of goods	2.95	3.02	3.08
Kilowatt-hours used per month per spindle	4.70	5.30	5.50
Number of Berkshire units* per month	1.15	1.35	1.27

$$\text{*Berkshire unit} = \frac{\text{kilowatt-hours}}{\text{yards}} \times \frac{\text{kilowatt-hours}}{\text{pounds}} = \frac{(\text{kilowatt-hours})^2}{\text{yard-pounds}}$$

costs reveals, and most textile mills can afford to pay, if necessary, more for purchased power (including the carrying charges on the investment required to electrify) than the cost of operating their own private plant. The increase in output resulting from steady high speed, the ability to operate efficiently under partial production and the resulting reduction in overhead charges per unit produced almost always more than justify the investment without other considerations.

That the cotton industry is in a state of depression is true, and ofttimes this is given as a reason for not changing to electric drive. Yet here is an example of a progressive, growing, textile manufacturing company that, even during the depression period, proceeded with electrification, knowing by its experience with its other electrified mills which are purchasing power that the step was in accord with excellent business judgment.

▼ ▼ ▼

Banked Transformer Structures Built for $280 to $314

By H. LESTER LIVINGOOD
Superintendent Distribution Engineering
Associated Gas & Electric System, Binghamton, N. Y.

TO SUPPLY medium-size power loads from 2,300- or 4,600-volt distribution circuits the simple transformer rack shown has been used with satisfactory results. Quite a number of individual power consumers reqire 100 to 300 kva. at 230 volts, three phase. This type load must have a short secondary feed in order to maintain good regulation and at the same time does not warrant an expensive installation such as meshed fence, concrete pad type, etc. Also a large number of consumers having loads of this type prefer owning their own transformers and being metered on the incoming primary side of the bank. Because of these facts, most of these installations are made on primary branches off the main feeders.

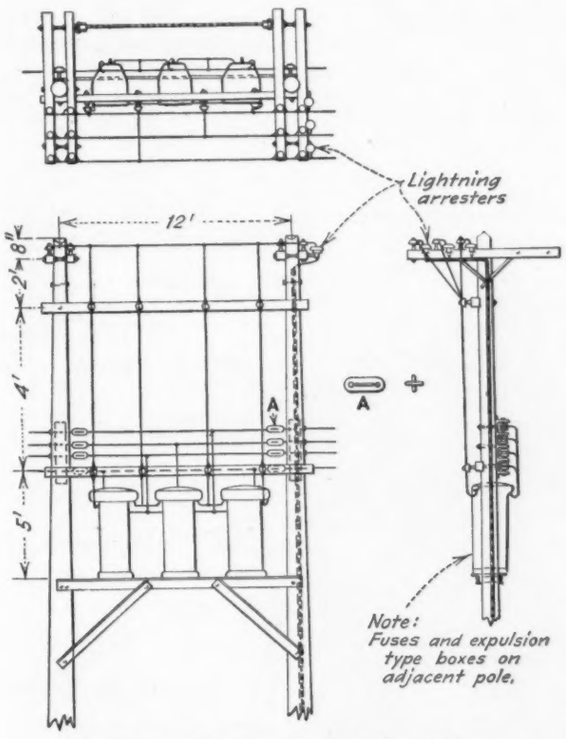
The lightning arresters are mounted on the incoming primary crossarm to insure protection. A lightning arrester placed even 40 ft. from the transformer it is to protect loses most of its portective value even with the best type ground connection.

Some companies mount fuse boxes immediately above the transformers, so a platform has to be added to enable workmen to re-fuse or test with safety. But in this design such a platform has been avoided without sacrifice by placing the load-indicating devices in each transformer and attaching the fuse boxes to a pole one span away on the incoming line.

When primary metering is to be employed a cabinet containing current and potential transformers is mounted under the incoming primary crossarm and the main feeder run down through it and back to the primary bus. A 1½-in. conduit carries the meter cord to a second cabinet, containing the meter, located 5 ft. from the ground. The cabinet is permanently grounded.

The total cost of material for the entire structure without power transformers on a 2,300-volt line is $280, and on a 4,600-volt line $313.75. When primary metering is omitted the total material costs are $136 on a 2,300-volt line and $147 on a 4,600-volt line.

Although this structure has been stripped of its platform, we feel that we have not subtracted from its appearance or usefulness.

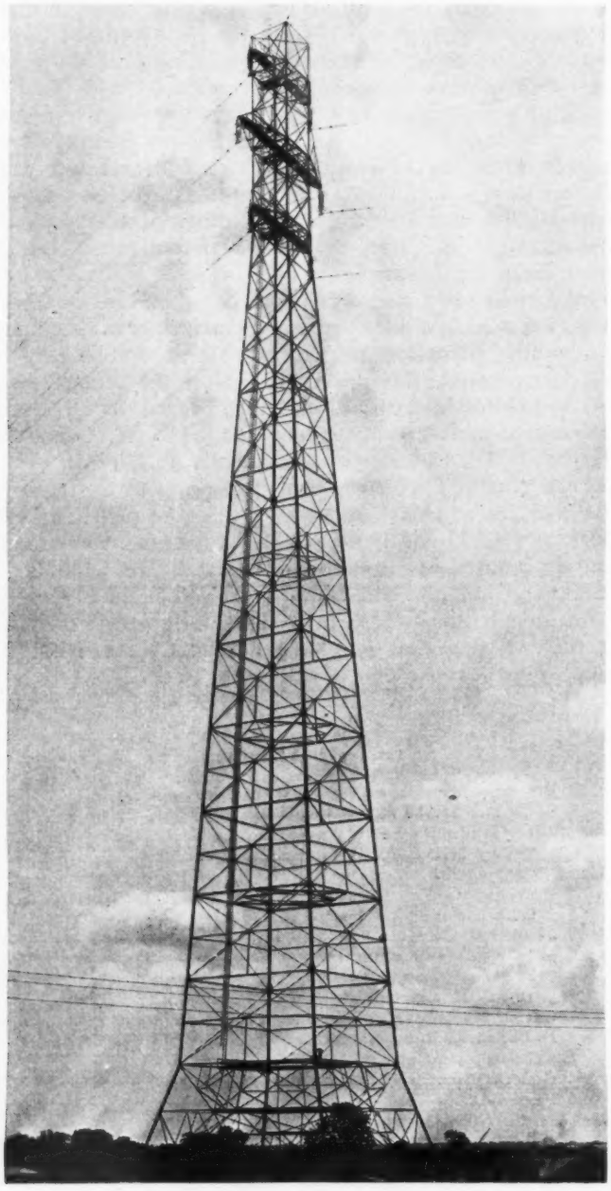


Rack for delta-bank of 37½-100-kva., 2,300/4,600-volt transformers

Bill of Material

20	Pin type insulators, No. 12847 (Westinghouse).
8	O. B. No. 26,830 strain insulators.
2	40-ft. (minimum height) poles.
4	3¼x4¼ by 8-ft. 0-in. six-pin arm douglas fir.
20	Locust shells.
20	Buttonhead fin bolts ⅝x10½ in.
8	⅝x5-in. carriage bolts with washers.
8	28-in. flat galvanized X-arm braces.
4	½x4-in. galvanized lag bolts.
4	⅝x20-in. spacing bolts.
2	⅝x18-in. through-bolts.
47	Galvanized square washers to go with bolts.
8	Hubbard clevises, No. 1535.
8	⅝x18-in. eyebolts.
3	General Electric expulsion type fuse boxes.
3	Fuse links.
2	Locke No. 6840 eye-nuts.
2	3-bolt clamps.
15	ft. ⅜-in. galvanized guy wire.
125	ft. 750,000-circ.mil cable for primary bus.
2	4x6-in.x14-ft. 0-in. wood crossarm.
2	4-wire secondary racks.
4	⅝x12-in. through-bolts.
4	6x6x⅜-in.x12-ft. 8-in. galvanized steel angle iron.
4	¾x12-in. through bolts.
72	ft. 2x6 plank (maximum amount) for transformer platform.
48	¾x3-in. machine bolts (maximum amount).
3	Lightning arresters 2,300-4,600 volts.
1	Copperweld ground rod.
40	Ground wire molding, ⅞x1 in.
10	1½-in. galvanized staples.
20	1,722 C. W. staples (copperweld).
3	Lb. solder.
¼	Lb. solder paste.
2	Lb. friction tape.

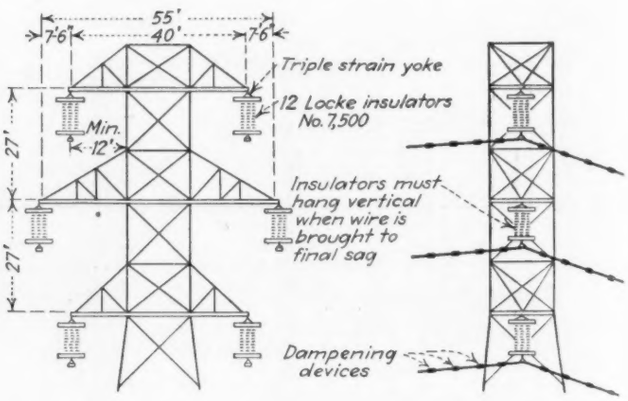
Mississippi River Crossing Requires

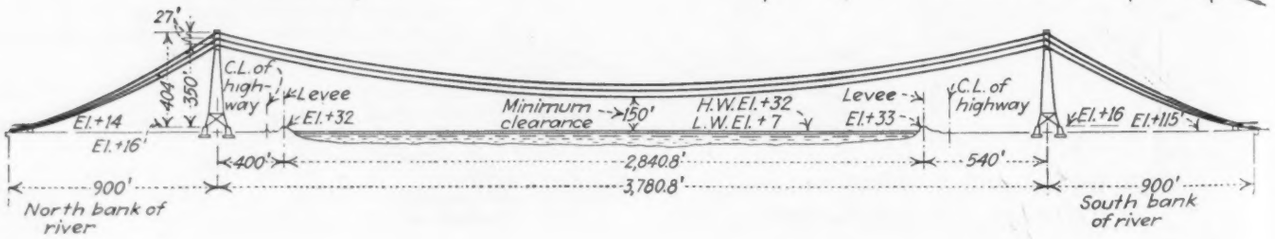


East bank tower of 3,780-ft. river crossing span

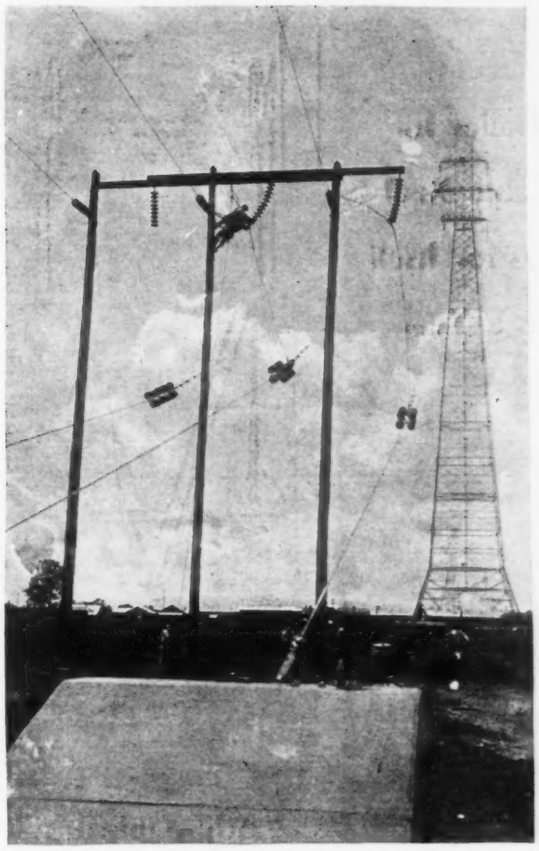
BECAUSE of War Department river-clearance requirements it was necessary for the Louisiana Power & Light Company to construct 417-ft. towers for a 3,780-ft. span transmission line crossing over the Mississippi River at Bonnet Carre, La. The line is an important 108-mile link in the 110-kv. tie between the Louisiana Power & Light Company and New Orleans Public Service, Inc.

The structural steel tower is 90 ft. square at the base, each corner resting on a sole plate with two $2\frac{3}{4}$-in. foundation bolts 13 ft. long buried in the concrete pier. These concrete piers are tied together with $2\frac{3}{4}$-in. steel rods and solid steel turnbuckles embedded in continuous concrete beams. Due to the low bearing value of the alluvial soil along the Mississippi River it was necessary to support the concrete piers and the walls on 252 wooden piles, 60 or 65 ft. long, for each tower. The upper portion of each tower is galvanized for a distance of 60 ft. below the lower crossarm and the lower portion is painted steel. The top and bottom crossarms are 40 ft. long and the middle crossarm is 55 ft. long, with vertical spacing of 27 ft. between crossarms. The tower is designed to withstand the loading of one broken conductor at 21,000 lb. and a wind load of 23 lb. per square foot on the projected area of one face. The total weight of one steel tower is 143 tons.



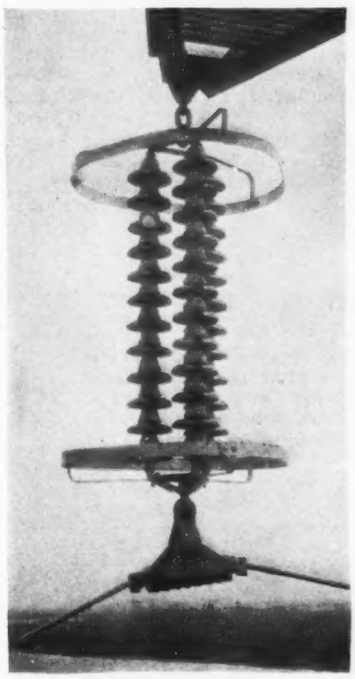


3,780-Ft. Span



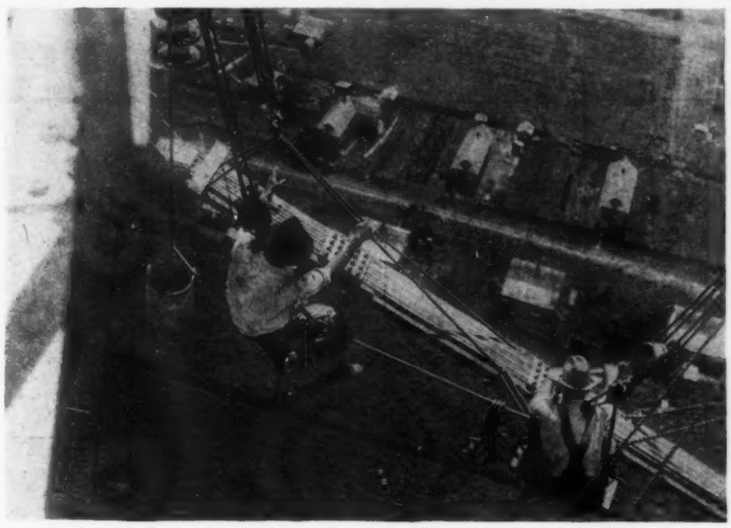
Tap-off structure and anchorage for east bank tower

There are six conductors installed and insulated for 110-kv. operation, although one circuit will operate at 13.2 kv. for the present. No ground wires are provided. Aluminum conductor, steel reinforced, is used in this crossing, with stranding of 20x 0.1158 aluminum and 37 x 0.0938 steel, and has a diameter of 0.8882 in. and weighs 1.127 lb. per foot. The maximum tension assumed was 19,000 lb. under $\frac{1}{4}$ in. ice and 8 lb. per square foot wind at 15 deg. F. The conductor was sagged in at 12,500 lb. and a sag of 165 ft. at 88 deg. F.



Suspension assembly from tower crossarm

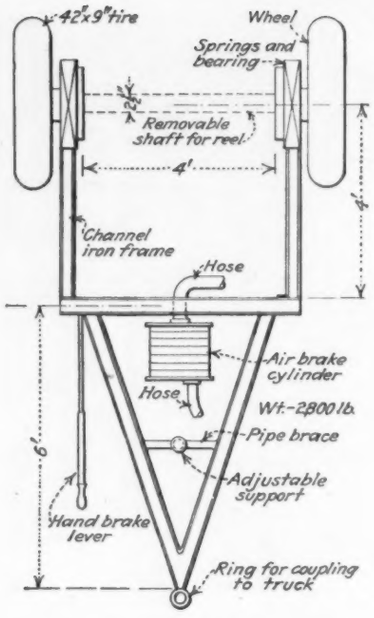
The insulator assembly supporting the conductor from the crossarm is a triple string with yokes and is protected by special shielding rings. There are twelve suspension insulators in each string, the complete assembly measuring approximately 8 ft. from suspension clevis on crossarm to the eye in the triple yoke at the bottom. The conductor is supported in a special three-groove two-piece aluminum suspension clamp designed for use with two damper cables. All three cables are securely held between the two parts of the clamp by means of $32\frac{5}{8}$ x $4\frac{1}{2}$-in. galvanized bolts with lock washer, nut and cotter pin. The two damper cables are secured to the main cable by eight parallel groove clamps on each conductor.



Damper cables during assembly

Each conductor is secured to a separate concrete anchorage located 900 ft. back of each tower. The aluminum cable is dead-ended to a quadruple string of insulators with yokes and clevises and is connected to the anchorage with $1\frac{1}{8}$-in. high-strength galvanized steel cable and turnbuckle.

Trailer for Cable Reel Pays for Itself in a Year



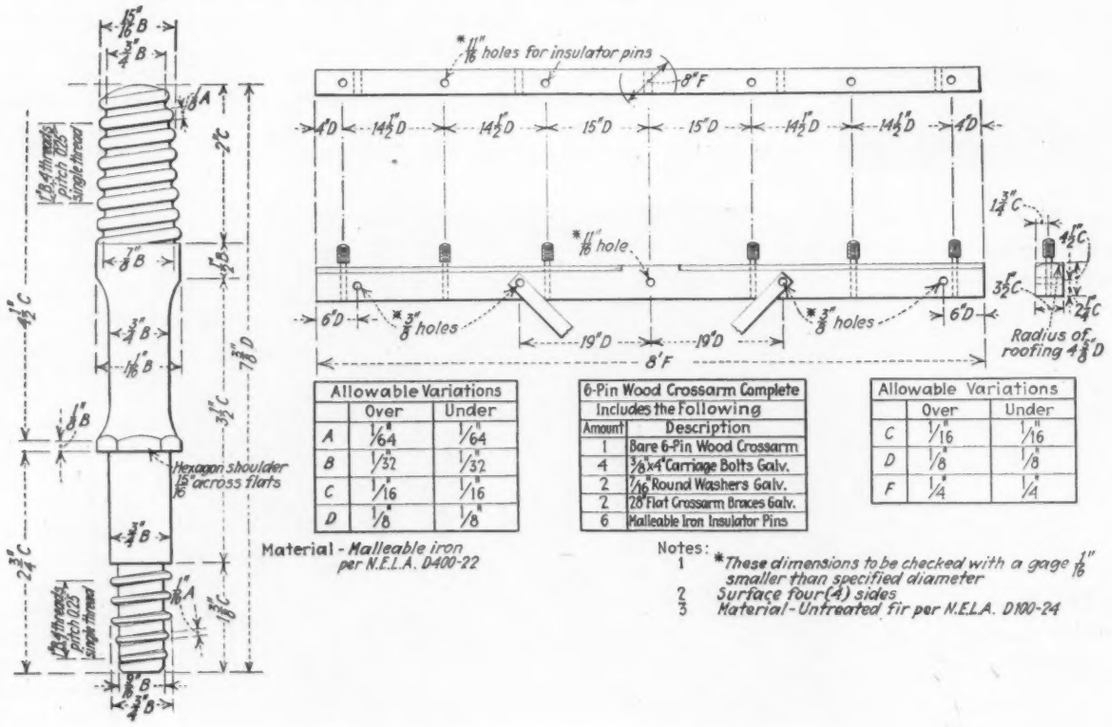
A cable reel trailer equipped with both hand and air brakes and weighing but 2,800 lb. has paid for itself within a year on the system of the Narragansett Electric Company, Providence, R. I., through the saving in labor and time effected in handling cable on busy streets.

ENGINEERING FOR BETTER

It will take a reel of 42 in. maximum radius and 48 in. maximum width. Normal height of the reel shaft is 58 in. above ground, giving ample clearance with a full reel. The front brace has a vertical supporting leg adjustable for height to adapt it to various sizes of trucks, and the trailer can be left at the pulling point after uncoupling from the truck with minimum obstruction to traffic. On jobs where the reel is hauled to the work without stowing it on the pulling truck the saving in time has proved most advantageous. The first cost of the trailer, which was made by the Highway Trailer Company, Edgarton, Wis., was about $900.

Adjustable Insulator Pin Aids Linemen

The Narragansett Electric Company, Providence, R. I., has developed a malleable iron pin for low-voltage insulator service with provision for adjustment in position on the crossarm, with consequent absorption of strains. The lower end of the pin is threaded to fit the hole bored through the arm, the pin being driven into the arm up to the hexagonal shoulder and the upper threaded end is covered with two layers of friction tape, which acts as a flexible cushion between pin and insulator. The hexagonal shape of the shoulder makes it possible to adjust the insulator by using a wrench to twist it to the proper angle while the line is in active service.



Allowable Variations		
	Over	Under
A	1/64"	1/64"
B	1/32"	1/32"
C	1/16"	1/16"
D	1/8"	1/8"

6-Pin Wood Crossarm Complete Includes the Following	
Amount	Description
1	Bare 6-Pin Wood Crossarm
4	⅜"x4" Carriage Bolts Galv.
2	7/16" Round Washers Galv.
2	28" Flat Crossarm Braces Galv.
6	Malleable Iron Insulator Pins

Allowable Variations		
	Over	Under
C	1/16"	1/16"
D	1/8"	1/8"
F	1/4"	1/4"

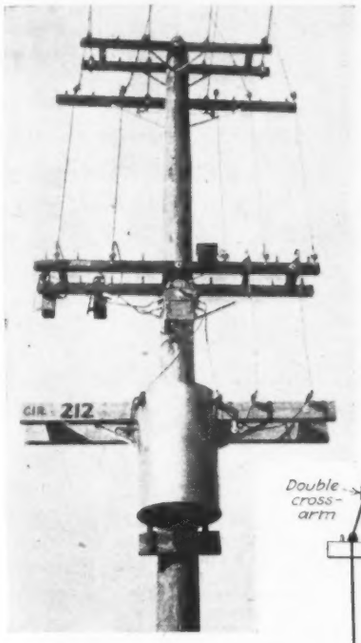
Notes:
1. *These dimensions to be checked with a gage 1/16" smaller than specified diameter
2. Surface four (4) sides
3. Material - Untreated fir per N.E.L.A. D100-24

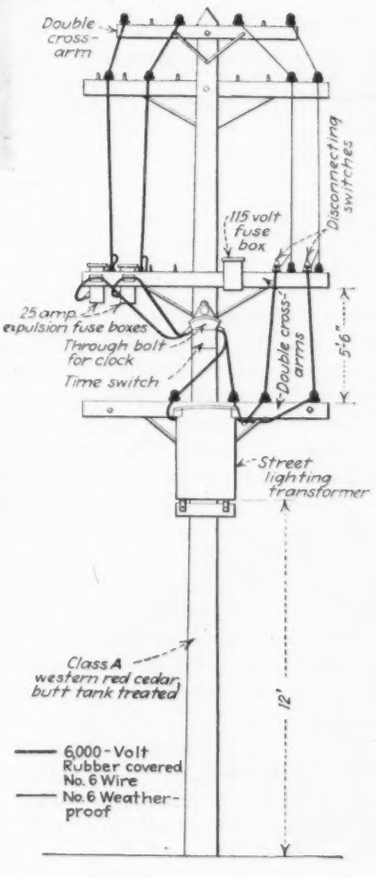
Pole Type Street-Lighting Transformer Installations Render Good Service

Twenty-five pole type street-lighting transformer outfits have been in service during the past three years on the system of the Fall River Electric Light Company,

LINES AT LOWER COST

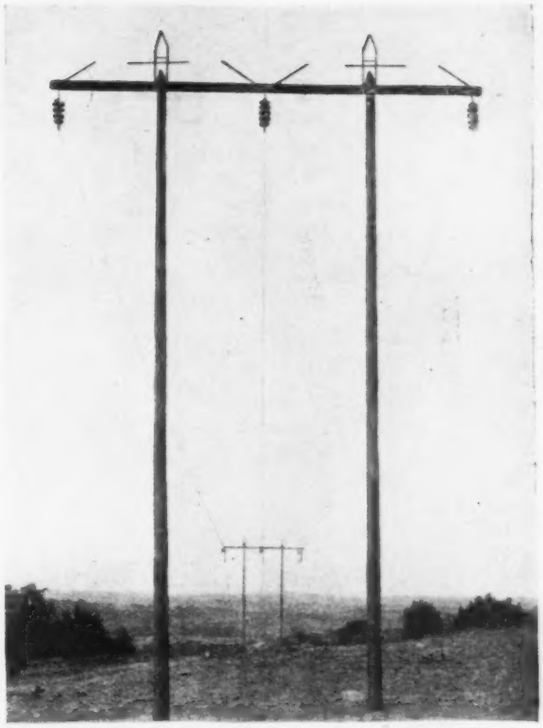
showing advantages in material economy, convenient maintenance and safe operation. To conserve space and reduce first cost





the company utilizes its distribution poles to support 30-kva. series transformers about 12 ft. above the ground, the installation also including a Sauter astronomical type time switch, a 115-volt fuse box for the motor circuit of the clock, and expulsion type fuses for the transformer. The transformer, weighing about 1 ton, is carried on the pole independently of the crossarm in order to avoid straining the wiring.

Wood Crossarms Increase Lightning Insulation



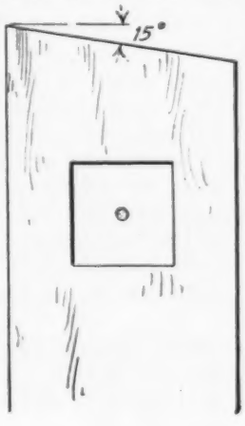
Conventional overhead ground wires, when conditions are favorable, may intercept some of the less severe direct lightning strokes without permitting them to terminate on the transmission conductors. It therefore seemed particularly important to maintain as much impulse insulation between the conductors and overhead ground wires as possible, and the wood crossarm affords a relatively inexpensive means of materially increasing the insulation when it is practicable to use the wood without danger of burning due to insulator leakage current.

On the Lampasas-Evant 66-132-kv. and two other 66-kv. lines of the Texas Power & Light Company provision has been made for the future installation of overhead ground wires and protecting horn gaps have been applied to the crossarms to prevent damage to the crossarm due to lightning discharges, thus permitting the utilization of the impulse insulation strength of the wood without impairing its mechanical reliability.

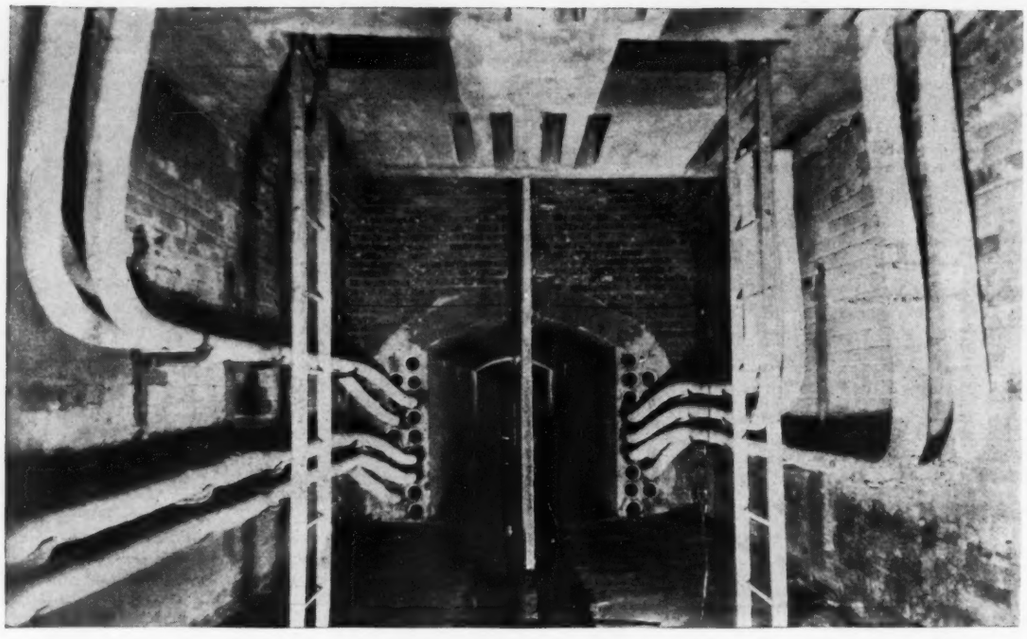
Experience indicates that protecting gaps can be made effective in preventing crossarm damage.

One-Way Roof Cut Improves Wood Poles

Instead of cutting a peaked roof on wooden poles, as has long been the accepted custom, a number of organizations, including telephone and electric light and power companies, are now using a single cut, at 15 deg. to the horizontal in a plane at right angles to that of the grain for crossarm placement. The advantages, as summarized by engineers of the International Creosoting & Construction Company, Galveston, Tex., are that (1) checking is reduced, since the natural cleavage point of the pole is not emphasized as in two-way roofs; (2) better drainage is provided, since moisture drains more freely from the weathered cups formed between springwood and summerwood, and (3) preservative is conserved, since evaporation is a surface phenomenon and there is much less surface on a one-way than on a two-way roof.



Concrete Cable Tunnels Show



One of the enlargements in the main tunnel

These chambers provide space for splicing the cables in the main ducts and those later to be carried on the center stanchions. They also give access to the cross tunnels above which lead into shafts for connections to conduits near the ground surface.

The section of tunnel shown is designed to carry 32 cables in the ducts at the sides, where cables are now shown, and later cables can be installed at either side of the center stanchions, where 28 cable positions are available. The main tunnel continues from this chamber in smaller section and is built to carry 24 cables, the same as the small lateral tunnels at the upper level. These cables are 2,500,000-circ.mil, single-conductor, direct-current, 240-volt feeders from the Farmer substation into the downtown network. Their outer terminals are in circuit breakers mounted in cast-iron barrel-like boxes at the street surface, with each positive and each negative cable feeding two 1,000,000-circ.mil, single-conductor cables running from small buses in these circuit breaker boxes to the ordinary d.c. junction boxes in the regular street manholes near by.

IN THE tunnel construction outlined here, built to provide a path for cables where the streets of Detroit are so congested with various underground structures as to make the usual conduit outlets impossible or impracticable, there has been provided a cable path at about 140 per cent of the cost of regular underground conduit construction. This contrasts with earlier figures, seldom below 200 per cent and sometimes as high as 400 per cent, in other tunnels of the Detroit Edison Company. We feel that some additional saving is to be had in future work through better design of the structure, better control of ingredients and an increased familiarity with this type of construction. More than 2,000 ft. of this design in four tunnels has now been built and is in use, so that something definite is known of it. The main tunnel is nearly 1,100 ft. long, with about 400 ft. of smaller tunnel, at an average depth of 67 ft.

Our general practice had been to build a brick tunnel of, roughly, horseshoe shape and then install conduit or cast-iron standards and cable arms for carrying the cables. Study of the relative merits of the two methods of supporting the cables disclosed a very considerable money saving in the use of conduit rather than cable standards and arms and fireproofing. Further study also indicated that another considerable saving could probably be made by combining the two operations of tunnel building and conduit installation. Concrete seemed to be the obvious solution, and after considerable debate and airing of fears regarding construction difficulties we agreed on the design indicated in the accompanying drawing. The tunnel sections combine the two structures of tunnel and conduit into one monolith, and it is this idea which permits of the greatest single economy of the design, which is a very considerable reduction in the volume of excavation as well as the volume of masonry lining.

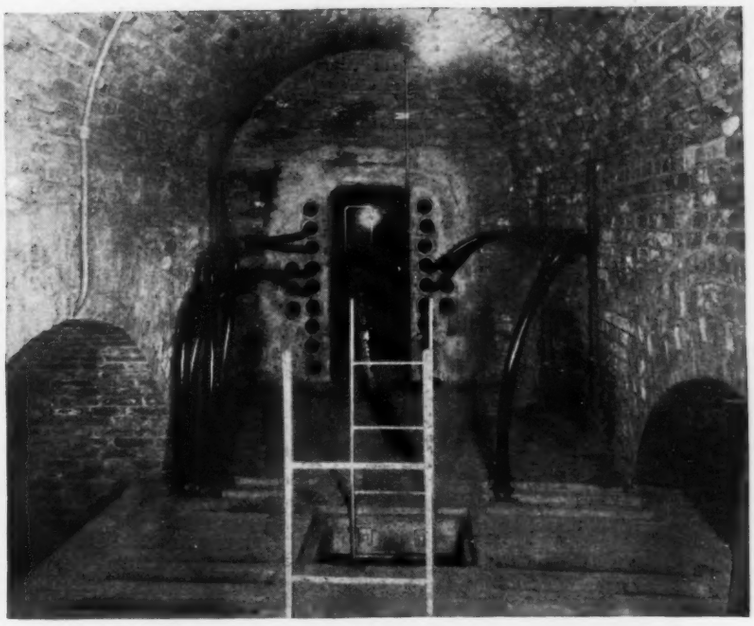
These tunnel sections provide very good cable facilities, affording excellent cable splicing room, reasonably easy cable pulling, and aisles for passage through the tunnel. The smaller tunnel affords a passage 2 ft. 2 in. x 5 ft. 6 in. and ducts for 24 cables, with enlarge-

Economy

By RUSSELL A. COLE

Underground Engineer
Detroit Edison Company, Detroit, Mich.

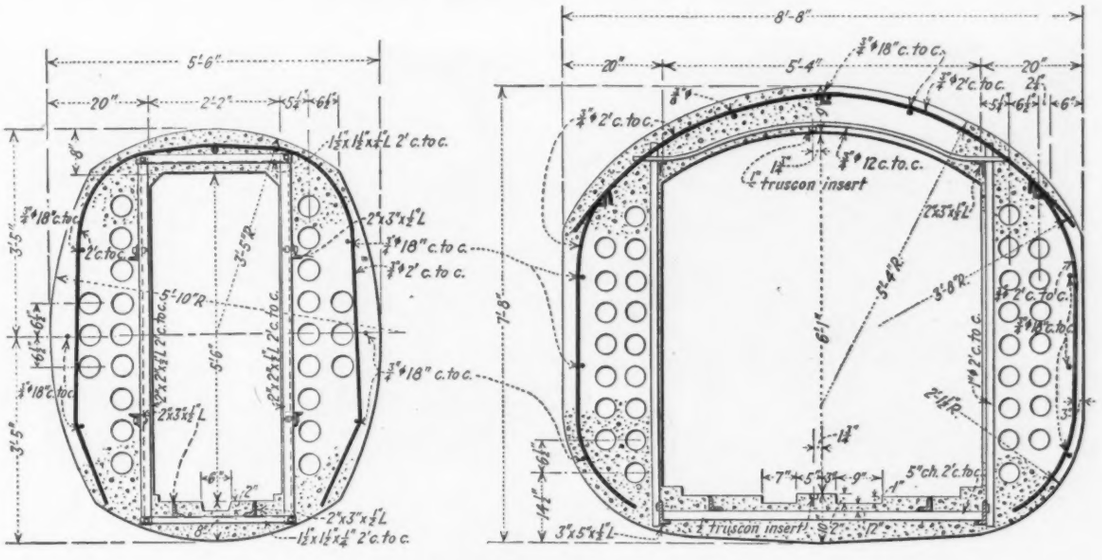
MONOLITHIC tunnel structures with ducts in the side walls for cable paths deep below the underground congestions of downtown streets can be built at distinct savings over the usual bricked construction. The strength of the structure is greater and it is better from an operating standpoint.



The lateral tunnels connect with the conduits near the surface

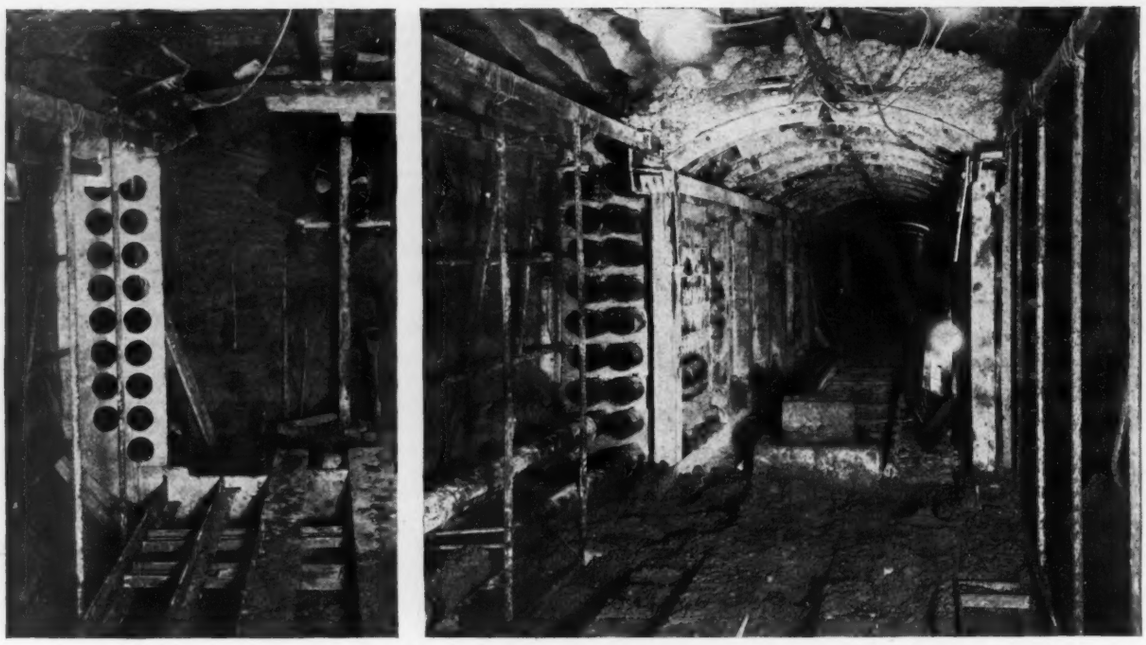
This is the upper story of an enlargement in the main tunnel, the floor of this upper level being the concrete platform which appears as the ceiling in the other picture. This platform is about 57 ft. below street surface. The small tunnel has the ducts continuous along about 60 ft. of tunnel and 45 ft. of vertical shaft at the far end, fiber sweeps of 3 ft. radius providing the 90-deg. bend at the bottom of the shaft. The upper end of these ducts is at the floor of an ordinary surface manhole. As shown in these pictures splicing chambers with but one exception are of brick. The one exception was the last chamber built, and our experience with it makes us feel they might better all have been concrete.

ments in the tunnel, at intervals, for cable splicing. At these intervals the cables are exposed on cable arms in about the same manner as they are everywhere along the center of the larger tunnel, in which there are two passages, each 20 in. by about 5 ft. 6 in. We have concluded that these aisles are rather small, a minimum of 24 in. being desirable even where the limits of the passage are defined by smooth walls rather than the projecting ends of cable supports. This design, having nowhere less than half of 1 per cent of steel judiciously



Tunnel and ducts are a monolith

The large section is of the main tunnel at a depth of 67 ft. and the smaller is of the lateral immediately above it. These concrete structures cost less to build than brick ones and are about three times as strong. Along the center line of the larger is a row of stanchions on which additional cables may be carried on arms as in usual practice.



Construction was rapid

Closely following the excavation came the template that aligned and provided support for the ducts while the steel was being put in. Turning his camera in the opposite direction the photographer made the right-hand picture, which shows the steel in place and the concrete close behind.

placed in both the concrete and brick walls, is considerably more than three times as strong as our older circular and horseshoe tunnels of plain brick.

Construction of the tunnel proceeded at the rate of 10 ft. to 12 ft. per day of two eight-hour shifts. Ground conditions were generally favorable, though there were soft spots, particular trouble being encountered at the bottom of the working shaft. This trouble necessitated the use of quick-setting cement, which was used throughout in spite of its increased price and heat-generating properties. This heating, together with that produced by nearby steam tunnels of our own, at times made a thoroughly uncomfortable atmosphere in the headings, where air temperatures were sometimes above 80 deg. F. and actually reached 90 deg. at a point where the tunnel crossed 10 ft. below our large steam tunnel. These temperatures were in July and August at depths 60 ft. to 70 ft. below the surface.

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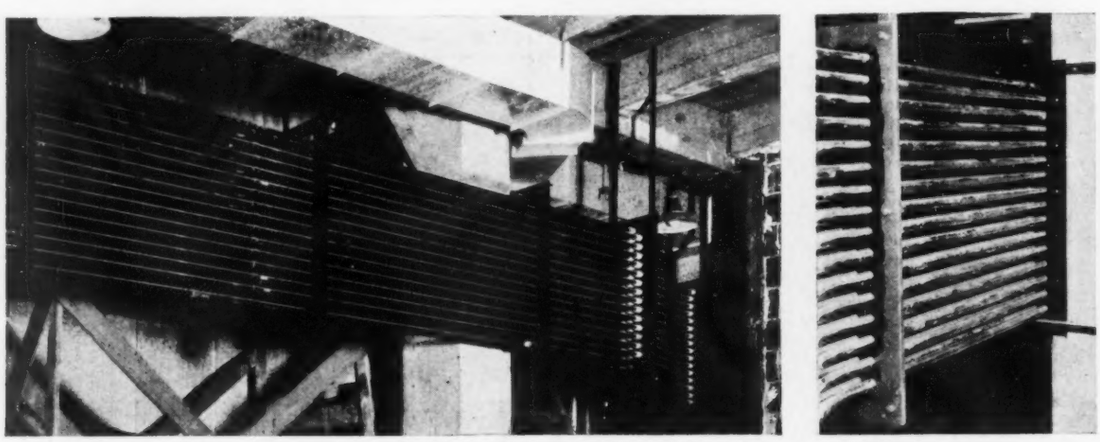
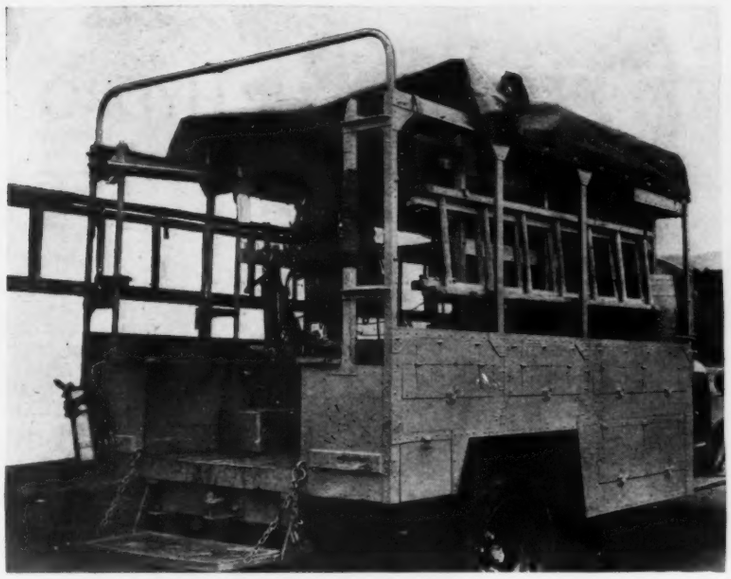
Simple Flexible Conduit Installation



In building a new substation in the basement of an office building in Portland, Ore., engineers of the Northwestern Electric Company decided to mount the conduits for control circuits in the manner shown instead of tearing up the concrete floor and installing them beneath. The method of construction employed not only saved money in this case but resulted in a neat, flexible installation that may easily be altered or added to with future expansion. Even in new substations the idea has considerable merit. It avoids a maze of conduits beneath a concrete floor, eliminates danger to the circuits from moisture and permits changes in apparatus or control circuits to be made with a minimum of cost.

As shown, the method of mounting was to cut round holes of proper size in a steel plate and to attach this plate with angle iron to the ceiling or columns, as most convenient.

Metal Line Truck Bodies Increase Pay Load



Duralumin body on 1½-ton chassis increased pay load 41 per cent

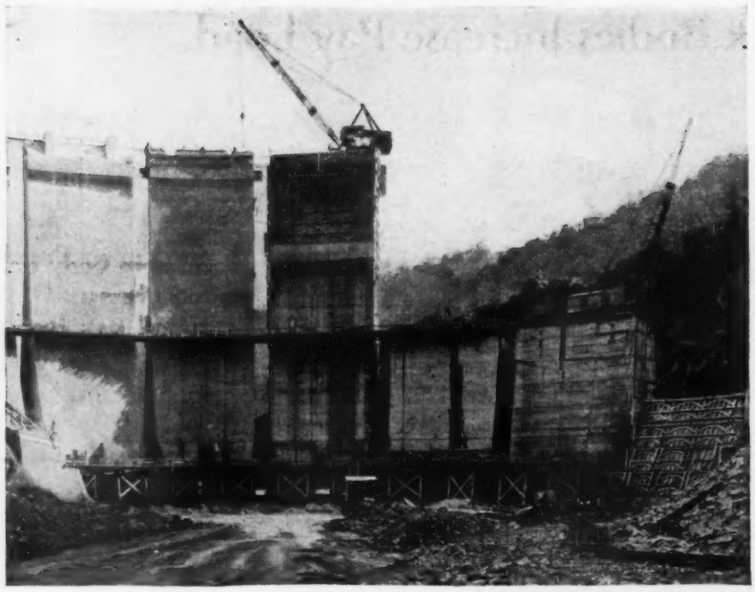
IN AN effort to increase the "pay-load" or material-carrying capacity of line trucks the Northwestern Electric Company, Portland, Ore., has built two metal-body trucks, one of duralumin and one of steel. Some surprising results in both cost and pay-load capacity, as compared with the lightest wooden bodies previously built, were found.

The duralumin body is for a four-man meter service truck on a 1½-ton Ford chassis. This chassis is designed for a 1,500-lb. body, but by using duralumin the entire body, with curtains, top and tail gate, weighs only 880 lb. For the same body cost as with wood, this resulted in an increase in pay-load capacity of 620 lb. or 41 per cent. The total cost of the body was $880 and the overall cost, including chassis, was 41.2 cents per pound. A steel body for this chassis would have cost only $475, but would have weighed 1,480 lb.

The steel body is for a four-man line truck on a 2-ton chassis. This body complete weighs 1,660 lb., or 620 lb. less than the lightest equivalent wooden body previously built. The first body cost $700, but a second body could be built at a saving of 20 per cent. This compares with a cost of $600 to $900 for comparable wooden bodies.

The duralumin body was built of rolled duralumin structural members with wooden paneling and bins, while the steel body was made of formed plates with welded joints and required no wood. Experience with these two bodies is that both duralumin and steel have a very definite economic field in the construction of line truck bodies, depending upon the size of the chassis. Design and supervision of construction was in charge of Fred S. Beach, assistant engineer Northwestern Electric Company.

All-steel line truck body decreased weight 620 lb. as compared with equivalent wooden body



and built the next section toward the left bank. In this way, with the lower whirley just ahead of the upper one, both whirleys moved from the right to

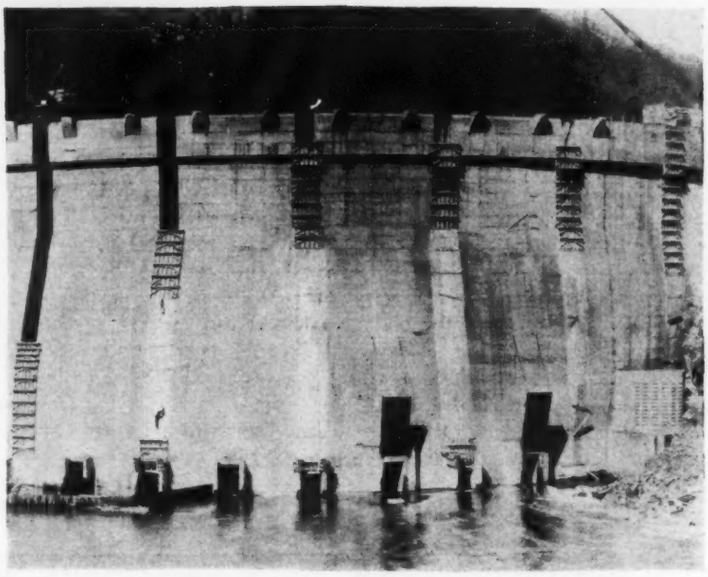
HYDRO CONSTRUCTION

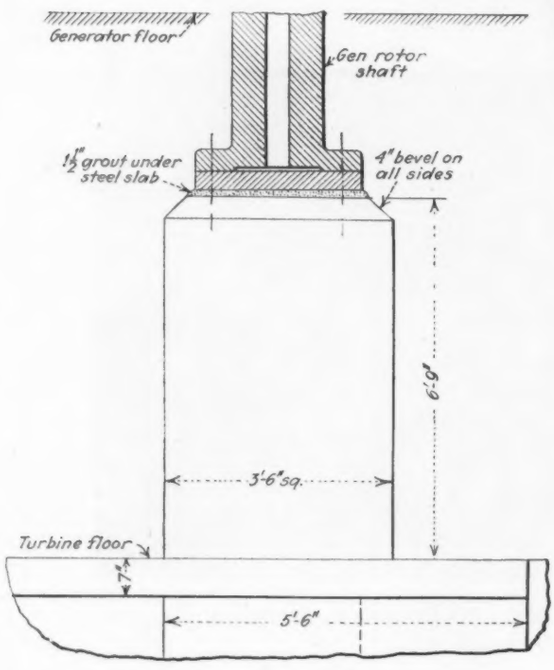
the left bank, placing all the concrete in the 48-ft. sections.

The 8-ft. section slots were filled, leaving nine openings at river level for final closing. The sectionalized construction gave a large flood discharge capacity during erection of the dam and permitted complete cooling of the sections before the slots were filled.

Construction Plant Minimized in Erecting Waterville Dam

But for 150 ft. at each end, all the concrete for the Waterville Dam of the Carolina Power & Light Company was placed by means of two electrically operated Wiley whirleys, one operating about 100 ft. above the riverbed and the other on top of the dam. Each whirley was started on the right bank and built the next section toward the left bank up to its own level. The whirley was then moved out onto the section just constructed

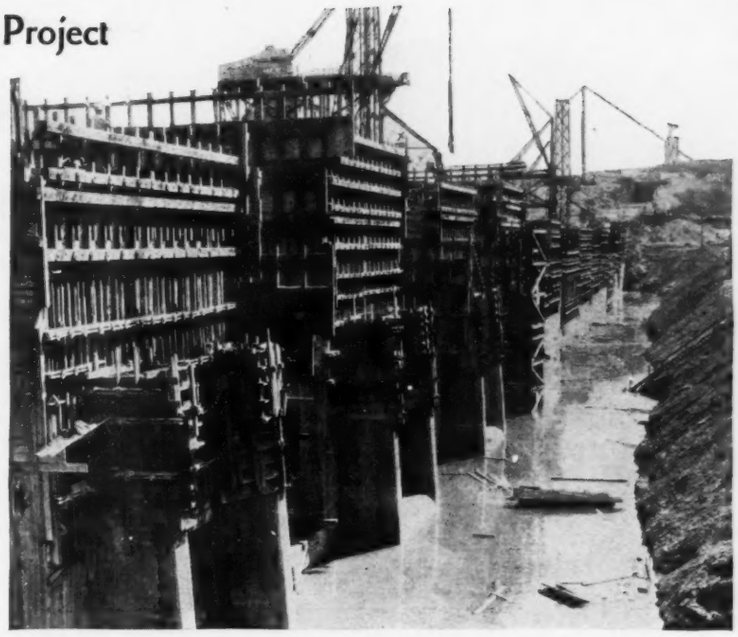




Generator Repair Pedestal Saves in Hydro Construction

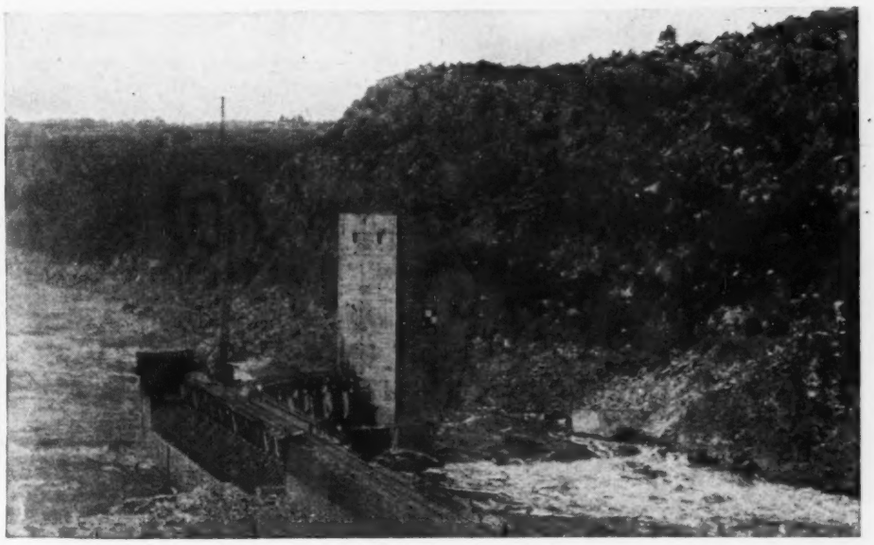
Structural costs were reduced at the Prospect No. 2 hydro plant of the California-Oregon Power Company by a simple device that permits lighter construction of the generator floor. When it is necessary to repair generator rotors and such work is done anywhere on the generator floor, the whole floor must, of course, be strong enough to carry the weight at any point. Such strength is not needed for any other purpose, and at Prospect No. 2 a pedestal was carried up from the plant foundation. Its top, capped with a steel plate fitted with centering pins and studs to engage the coupling on the lower end of the rotor shaft, is about 3 ft. below the level of the generator floor, which has a hatched opening above the pedestal. The rotor is set on this pedestal and tightened in place. The rotor body is thus at easy working height for a man standing on the generator floor.

Diversion Sluices Useful on Osage Project



Five 10-ft. x 15-ft. Venturi sluices and four of the 34-ft. wide alternating notches comprising the temporary river diversion works through the Bagnell dam of the Osage project for the Union Electric Light & Power Company in Missouri are shown in the accompanying halftone. These combined notches and sluices will divert the river flow during the construction of the power-station section of the dam and will have a discharge capacity of about 90,000 sec.-ft. The sluices will divert the flow during closure of the notches. The sluices will be closed with concrete sliding gates at the upstream end and will then be plugged with concrete. Extensive experiments were conducted with models to determine the most effective design of this structure. The Stone & Webster Engineering Corporation, Boston, is building this plant.

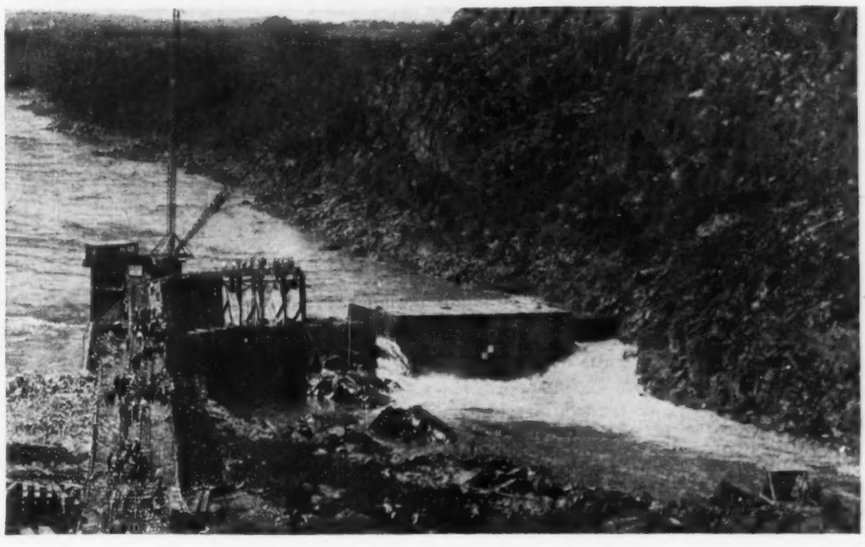
COSTS REDUCED



92 ft. long, 45 ft. wide and containing 5,400 cu.yd. of concrete, was tilted into position from a vertical placement on two piers on an island in the river. The dam was constructed in the vertical position, its lower face being contoured to fit the river bottom. The pier on the side toward the channel was blasted away and the precast dam rolled over the remaining pier and fell in place. The 11,000-ton mass fell in 30 ft. of swiftly moving water and came to rest within 1 in. of the calculated position.

The water cushioned the fall so completely that the huge block settled in place without being broken, fitting the bottom closely and forming a very economical and satisfactory cofferdam.

Precast Dam Closes Narrow Channel



In constructing the Chute à Caron hydro plant on the Saguenay River, Quebec, ordinary methods for providing diversion of the stream to a new channel could not be used because of the river flow of 40,000 sec.-ft. at a velocity of 20 ft. per second which was encountered. Engineers of the Aluminum Company of America solved the problem in an unusual way.

When diversion of the new channel was desired, a precast concrete dam,

Production Methods Applied to Wiring

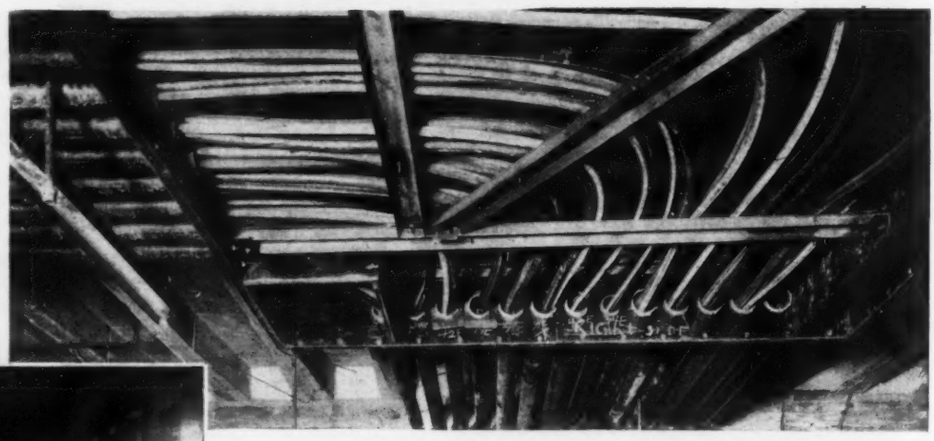
ADHERENCE to a planned working schedule, development of technique for typical areas repeated throughout the job, use of specialized crews, bending conduit ahead of the schedule, standardization of outlet boxes and cabinets, pulling wire by machine and liberal use of power tools —these methods enabled the A. S. Schulman Company to do a production job on the wiring of the world's largest building, the Merchandise Mart in Chicago. These production methods speeded up the work and also improved its quality.

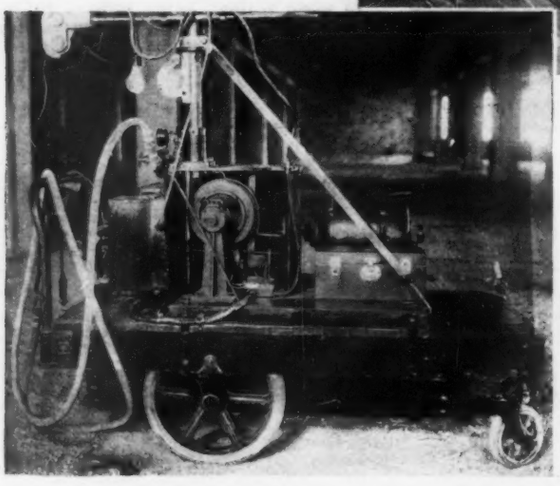
A back saver

A cable-pulling machine, simply a motor-driven winch on a hand truck, saved a lot of back-breaking labor in the pulling in of cables.

Corner boxes eliminate conduit bends

Fourteen conduit bends of different radii would have been required for this corner. The pull box here, and others in numerous locations, saved time, labor and money. Note the separate compartment for lighting cables as required by the code. The cables in the box rest on the cross channels, whose top surfaces are covered with fiber.





Fishing—modern style

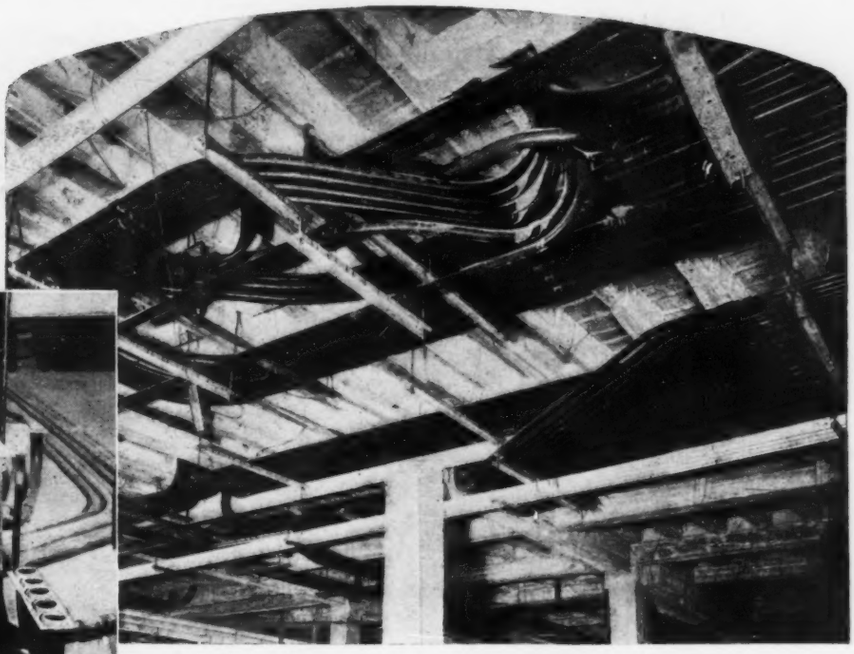
Compressed air was used to force the fish cable through the conduit, the cable reel having an automatic brake to prevent overrun when the plunger emerged from the conduit at the far end. The circuit wires, which because of the huge quantities required were delivered on 5,000-ft. reels, were next fastened to the fish cable, which was then pulled back, power for reeling in the cable being supplied by the motor on the truck.

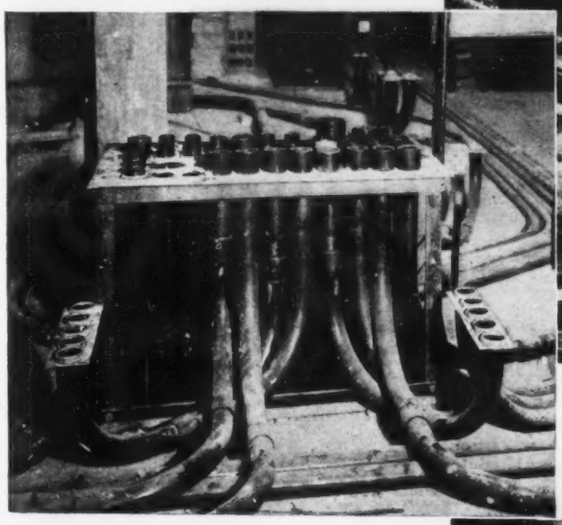
Air compressor a useful tool

Energized by a 1½-hp. motor and furnishing air at 150 lb. to the fishing and wire-pulling machine, the portable compressor found another very practical application, blowing out conduits. For locations where an electrical connection was not available the storage tank at 150 lb. pressure held enough air to blow an average conduit group.

Conduit templates helped

Feeders were carried between the nineteenth and twentieth floors in special raceways. Risers were held in templates while the floor slab was poured.



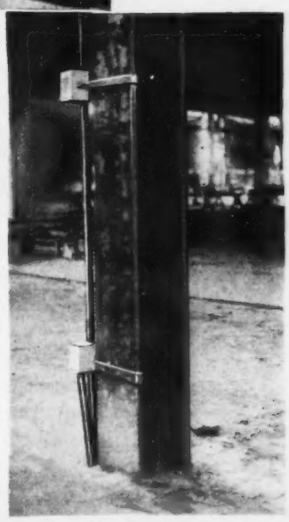


Planned ahead

The National Broadcasting Company has large studios on the nineteenth and twentieth floors of the Merchandise Mart. The extensive and diverse electrical services they required caused a great congestion of conduit, most of which had to be installed on the eighteenth-floor ceiling. Careful planning beforehand located each conduit exactly and provided slots for risers so that floors did not have to be cut after concrete was poured. Here is a picture of the eighteenth-floor ceiling.

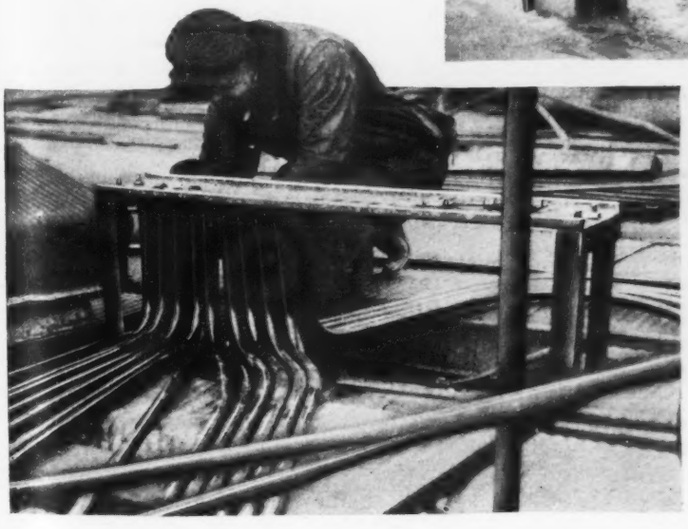
Outlet boxes exactly placed

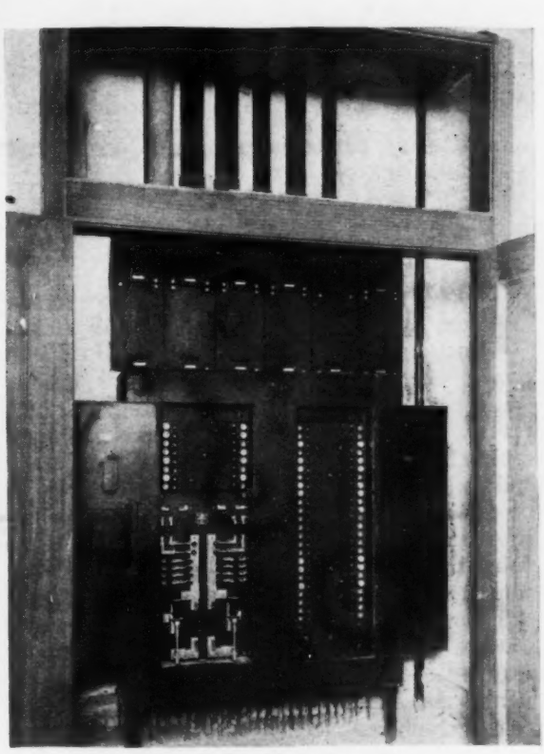
A simple bracket was used to hold flush outlet boxes, several thousand of them, on steel columns. When plaster or concrete then was placed on the columns the boxes were right where they ought to be.



Cabinets fitted right into place

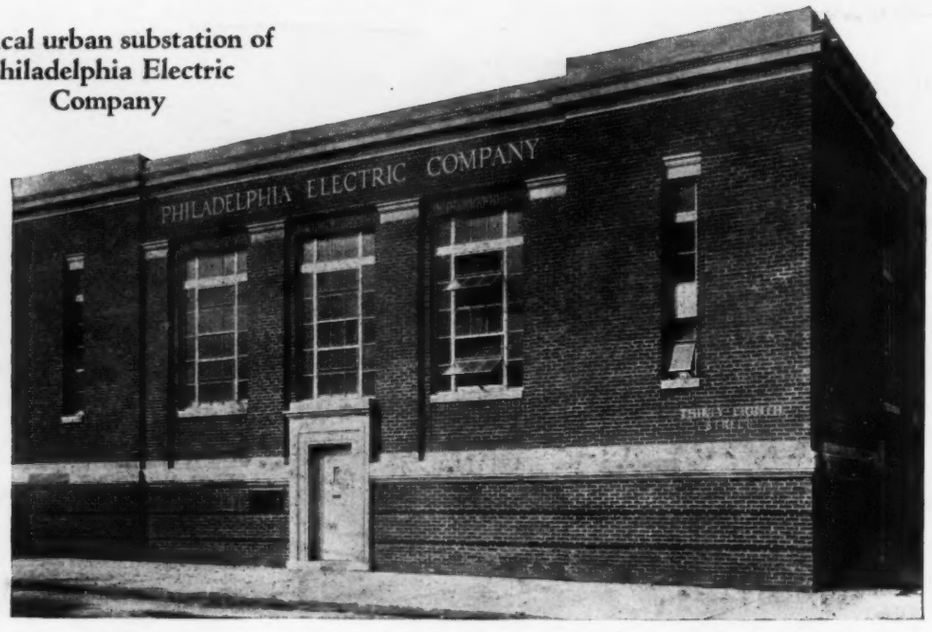
It was not necessary to spend time fitting cabinets to inaccurately spaced conduits. Conduits were held exactly in place by templates while concrete was poured. After it set the templates were removed and used on another floor.





A neat job

This is a typical Merchandise Mart lighting cabinet with panels above for tenant meters. The panels will receive any style or type of meter.



Typical urban substation of Philadelphia Electric Company

Distribution Substations

By R. A. HENTZ and P. J. ZERBE

Philadelphia Electric Company

Philadelphia Electric Company uses two general types, urban and suburban. Details of design and construction. Reasons for designs

TWO general types of distribution substations for supplying the territory in and around Philadelphia are employed by the Philadelphia Electric Company, namely, urban and suburban. The urban-type substations are supplied from generating stations or large transmission substations at 13,200 volts, three-phase, 60 cycles, part of the energy being distributed at this voltage and the remainder transformed to 2,400 volts, two-phase, three-wire, for distribution circuits. The suburban-type substations are supplied in the same manner at 33,000 volts, three-phase, 60 cycles, and transformed to 4,000 volts, three-phase, four-wire, for distribution circuits.

The accompanying single-line-diagram plans and cross-sections of the urban-type substation indicate the general features of design. It will be noted that all the equipment is housed and that 13,200-volt, three-phase, to 2,400-volt, two-phase, airblast transformers are used. The indoor type of distribution substation is used within the city limits for the following reasons:

(a) They are less expensive than the total outdoor arrangement of equipment or any combination of outdoor and indoor equipment, and they require less ground area, a big item in a large city.

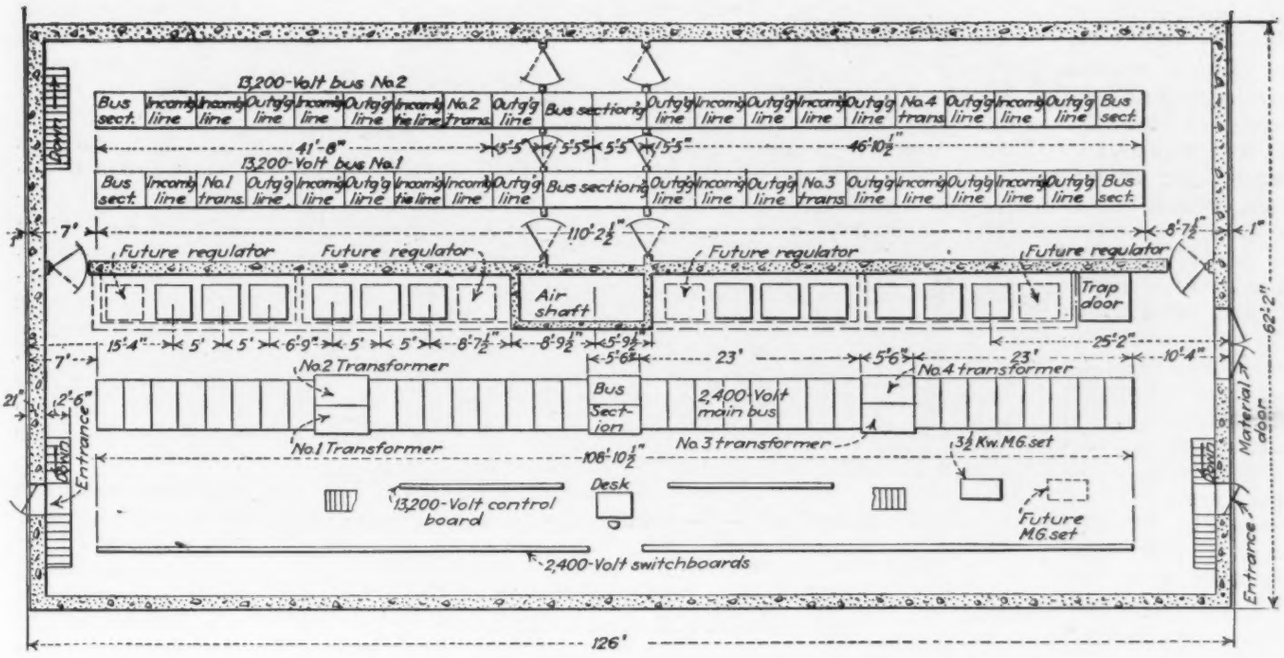
(b) The problem of inspecting and maintaining apparatus is simplified.

(c) They present a better appearance, an important factor in public relations.

In areas not in the central business district of Philadelphia the ring-type 13,200-volt bus is used, sectionalized at four points, with incoming lines and transformer banks connected to only one bus and the outgoing or industrial lines connected to two buses through oil circuit breakers. Provision is made for twelve incoming 13,200-volt lines, eight outgoing lines, four transformer banks (normal rating 7,500 kva. and emergency rating 9,500 kva. each), and a tie line to a source other than the one normally supplying a particular substation. Space is provided for reactors on outgoing lines only. Each line is rated at 6,000 kva. and connected to the buses through oil circuit breakers of 350,000 kva. interrupting capacity.

In the central business district the 13,200-volt equipment is similar, except that all lines and transformer banks are double-bused to insure the maximum flexibility.

It will be noticed in the accompanying illustrations



First floor arrangement of 13.2/2.4-kv. urban substation

Eight outgoing lines, twelve incoming lines, one tie, four sections, four transformers.

that the 13,200-volt equipment is separated from the 2,400-volt equipment by a brick firewall and the 13,200-volt equipment is further divided into three sections, the sectionalizing breakers occupying the center one. This arrangement prevents trouble spreading to adjacent equipment, thereby preventing the complete shutting down of the substation.

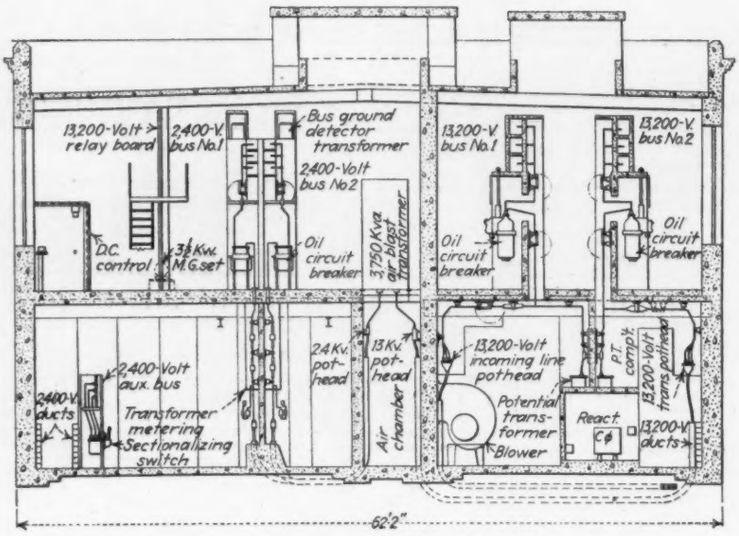
The 2,400-volt, two-phase, three-wire installation consists of two main buses, sectionalized in the center, each bus being supplied by one transformer bank. Each circuit is connected to two buses and is equipped with induction-feeder regulators, current-limiting reactors and a non-automatic auxiliary bus switch. The oil circuit breakers on the main buses are solenoid-operated with the control switches on their respective circuit panels. The auxiliary bus breakers are manually operated, with the handles on the same panels. Most of the distribution circuits are equipped with 200-amp., 10 per cent regulators. However, the compartments are large enough to accommodate 300 amp., 10 per cent regulators.

Provision is made for ultimately changing the distribution from 2,400-volt, two-phase, to 4,000-volt, three-phase, if it should ever be found advisable, and in order to accomplish this, space is reserved for a third transformer on each bank and a third regulator for each circuit.

All 13,200-volt and 2,400-volt cables enter and leave the substations underground, the ducts being arranged in vertical rows one duct wide, running the entire length of the substation. This arrangement gives practically 100

Typical suburban substation

per cent flexibility in that any cable may be brought to any compartment. In order to facilitate splicing of cables outside the substations without regard to phases, provision is made for this phasing of the leads at the potheads in the substation, thereby simplifying the work of the cable splicers. All 2,400 volt circuits are arranged with automatic reclosing equipment. Substations of this capacity have space for 31 distribution circuits, of which approximately half will be 200-amp., 10 per cent and the remainder 300-amp., 10 per cent, which gives the greatest all-around economy considering both substation and distribution investment.



Transformer and incoming line compartments of 13.2/2.4-kv. urban substation of the Philadelphia Electric Company

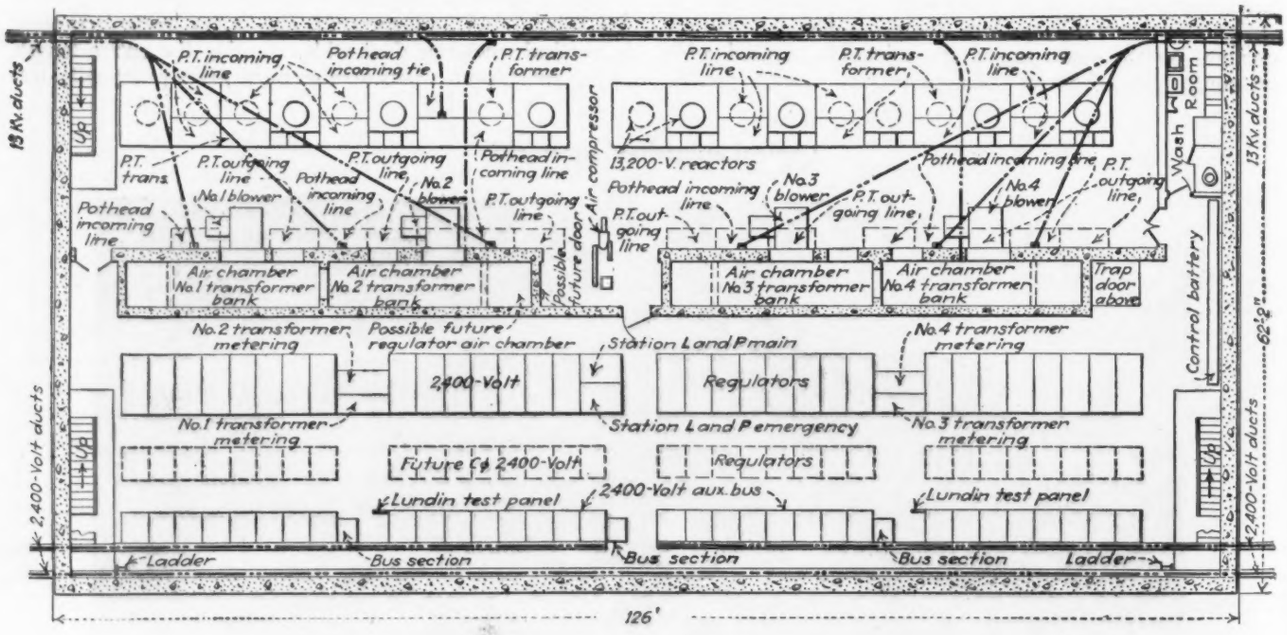
Station light and power is obtained from two 150-kva. transformer banks, one bank being connected to the main 2,400-volt bus and the other to the auxiliary bus. These banks provide power for the blowers on the airblast transformers, motor-generator set for charging the battery, electric space heater, lighting and other miscellaneous equipment.

An air shaft is provided in the center of the building, extending from the basement to the roof, with adjustable dampers above the roof and above the first floor, through which air is drawn to supply the blowers on the airblast transformers. By means of the two sets of adjustable dampers it is possible to recirculate the air inside the building in winter by closing the roof dampers, thereby helping to heat the building and in the summer time to obtain outside air by opening these same dampers. Skylights are provided with adjustable sash above the transformers for ventilation and light.

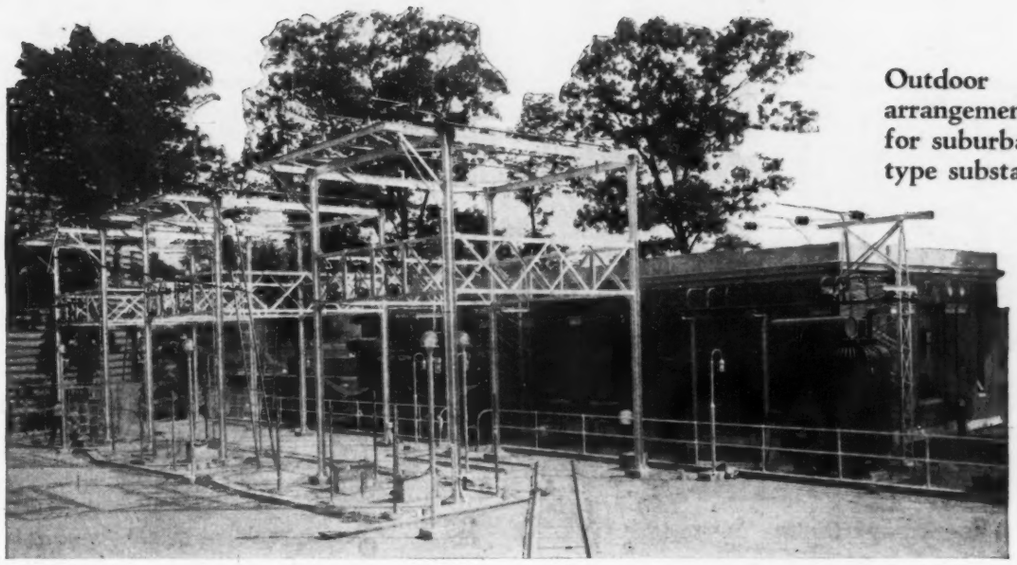
Disconnecting-switch guard lamps are inserted in the walls near the 13,200-volt disconnecting switches. These lamps are controlled by the oil-switch mechanism and indicate when lighted that the oil switch is open and that the disconnects may be pulled. This minimizes the chance of the operator accidentally opening "disconnects" under load, which occasionally happens in times of stress or mental diversion.

Small metal targets projecting from the compartment barriers or mounted flat on the structures are used to mark the individual compartments. Separation of circuits is further emphasized by painting broad red lines between sections.

Telephone drop signals are also installed to bring to the attention of the operator any occurrence such as



Basement arrangement of 13.2/2.4-kv. urban substation



Outdoor arrangement for suburban type substation

tripping of lines, transformer banks or failure of air pressure on transformers. Direct telephone connections are maintained between each substation and the system load dispatcher's office in the main office building.

All the 13,200-volt equipment is housed in concrete cells or compartments, with steel and asbestos hinged doors for access to the various equipment. The doors in front of disconnecting switches have clear glass panels, enabling the operator to observe the position of the "disconnects" without the necessity of having to open the doors. All doors on each compartment are locked by means of padlocks, thereby making it impossible for any maintenance or construction men to get into any of these compartments without the knowledge of the substation operator, who alone carries the key.

The main 2,400-volt buses and regulators are housed in steel and asbestos compartments with doors on the bus only, similar to those used on 13,200-volt equipment. The auxiliary bus is supported on an open steel structure with all conductors insulated.

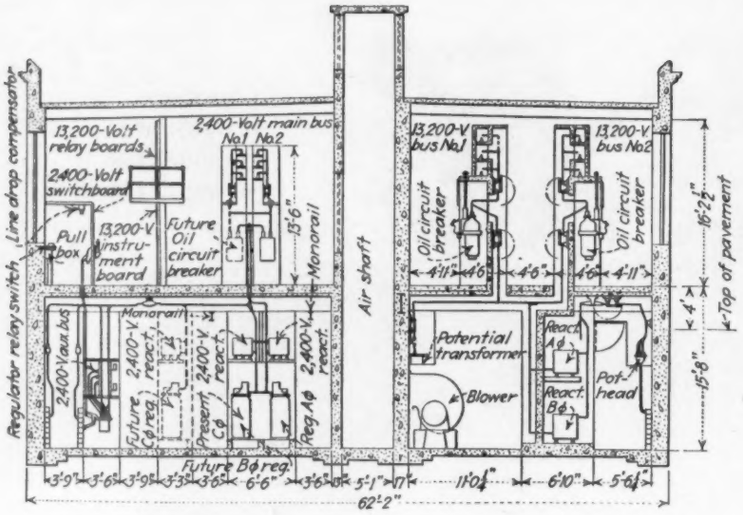
A sealed-type storage battery is installed in each substation to supply the necessary direct current for operation of the various solenoids on the oil circuit breakers, indicating lamps, emergency lighting and miscellaneous equipment. A motor-generator set floats on this battery.

During the early stages of each new substation the amount of equipment and load is such that the heat given off by the various equipment will not make the substation comfortable during the winter months. Electric space heaters are utilized for this purpose, and they may be transferred elsewhere when the load of the substation reaches such a point that they are unnecessary.

The design of this type of substation was essentially adopted about eight years ago and has been modified from time to time when experience indicated this to be desirable. This standardization allows operators to be transferred from one substation to another with a minimum degree of confusion.

In the suburban area two types of distribution substations are used, namely, the two-bank and the four-bank. In the less densely populated sections the two-bank sub-

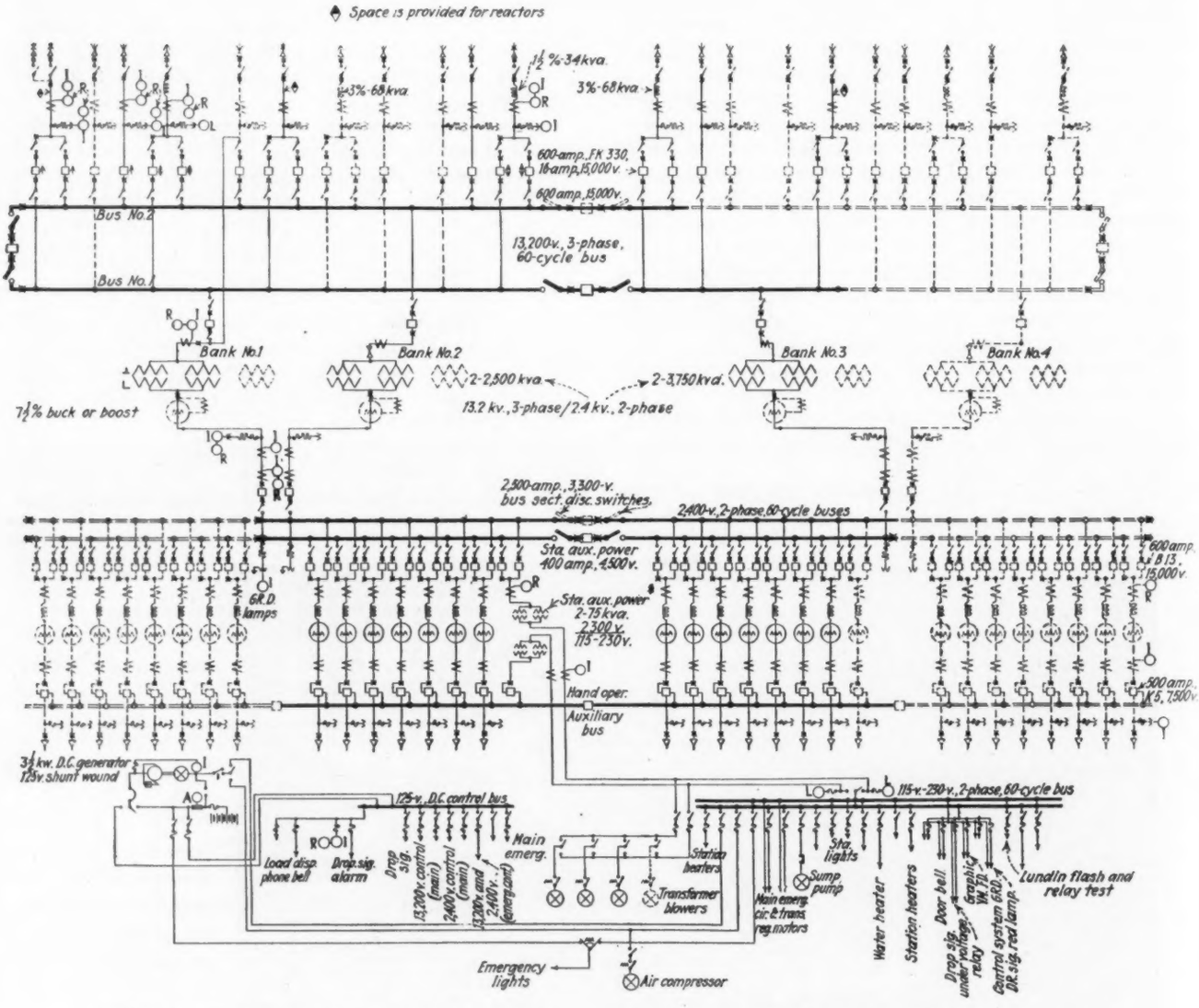
Interior arrangement and construction for urban substation



Outgoing-line compartments in standard 13.2/2.4-kv. urban substation

station is used. It is fully automatic. In the more densely populated sections, particularly those bordering on the edge of the city, the four-bank substation, either fully automatic or manually operated, is used. In both types of suburban substations the 4,000-volt distribution equipment is installed in a building, and the 33,000-volt equipment, including the 33,000/4,000-volt, three-phase, 60-cycle, O.I.S.C. transformers, outdoors.

The 33,000-volt equipment, as shown in the accompanying illustrations, provides for either two or four 33,000-volt incoming lines, tied together by means of 33,000-volt oil circuit breakers to form loop lines, and two or four 33,000/4,000-volt transformer banks. The substations are designed for 10,000 kva. (three single-phase or one three-phase) transformer banks, with forced air cooling to increase their capacity at 15,000 kva. each. Banks rated at 5,000 kva. will be installed initially, and these may be increased to 7,500 kva. by forced air cooling.



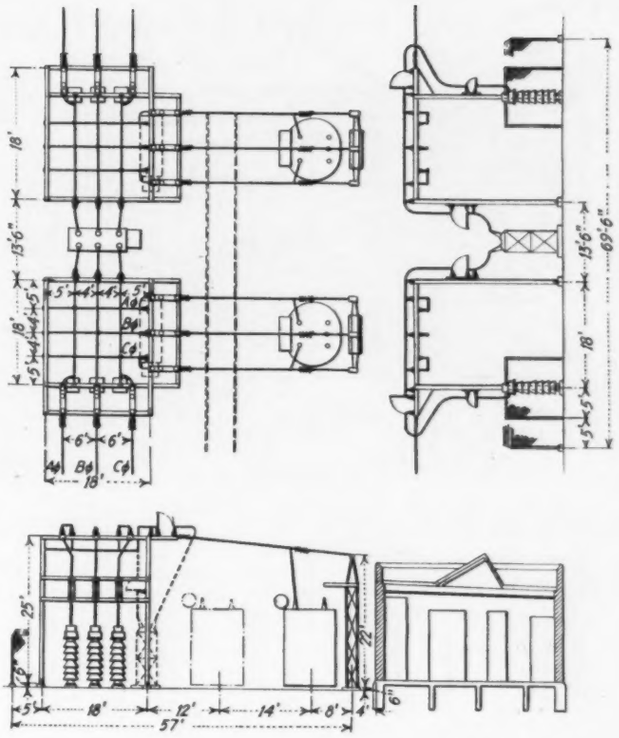
Single-line diagram for 13.2/2.4-kv. urban substation of Philadelphia Electric Company

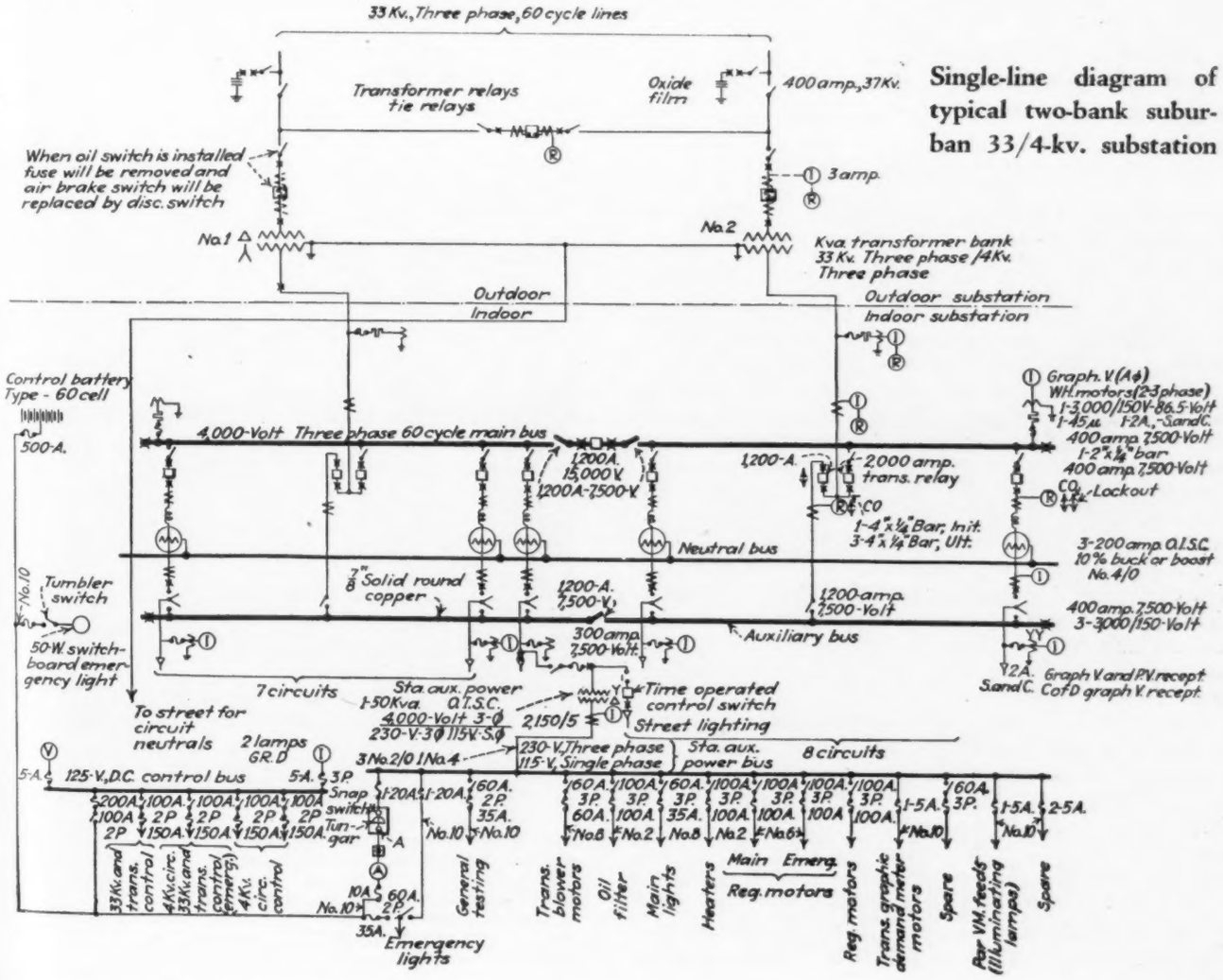
Arrangement of incoming 33-kv. lines on standard 33/4-kv. suburban substation

Space provisions are made for the installation when desired of a 33,000-volt oil circuit breaker on each transformer bank. Air-break disconnecting switches will be used initially where the 33,000-volt lines are direct from the source of power. Where the lines between the power source and the substation have taps to other substations or customers, the transformer banks are protected by the addition of fuses.

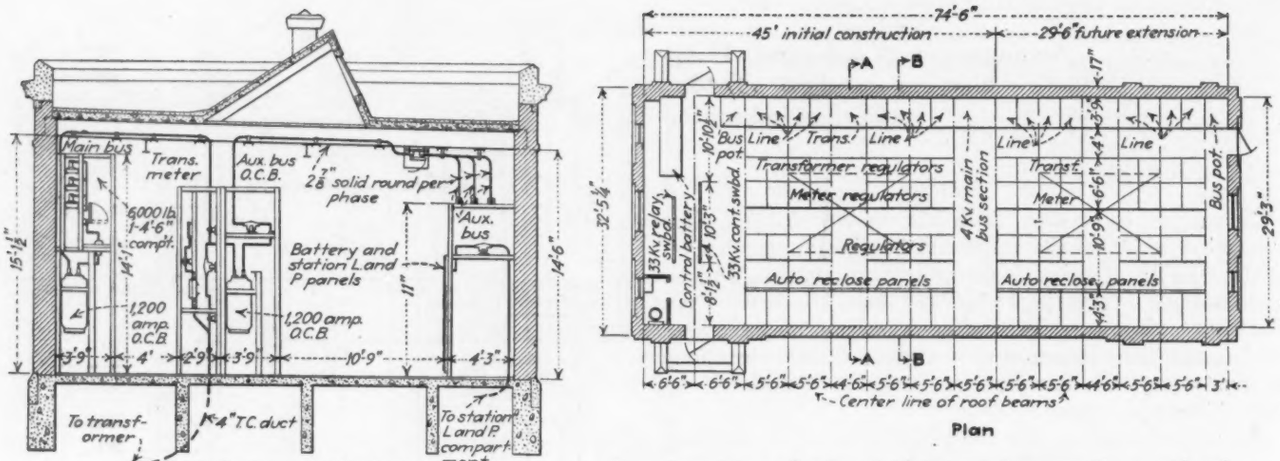
The transformers are installed adjacent to the building which houses the 4,000-volt equipment, with sufficient space between them and the steel structure for handling. The 33,000-volt supporting steel structure is designed to accommodate incoming lines entering from the rear or from either side as the right-of-way conditions may dictate. By the addition of a small amount of steel on the line side line breakers can be installed in the future. These steel structures are made in units, and one unit is used for each transformer bank.

The 4,000-volt, three-phase, four-wire distribution

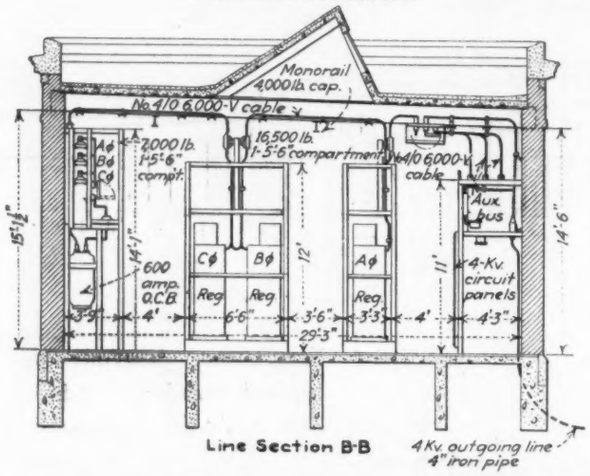




Single-line diagram of typical two-bank suburban 33/4-kv. substation



Arrangement of 4-kv. indoor equipment in standard suburban 33/4-kv. substation



equipment is all housed. The two-bank substation has the inclosed main 4,000-volt bus arranged along one side of the building next to the wall, with the oil circuit breakers mounted in cells below. Overhead connections are made to the three single-phase regulators arranged in a double and single row through the center of the building, with the reactors mounted directly above each regulator. Connections are then made to the selector disconnecting switches which are used to connect the circuits to the auxiliary bus. The auxiliary bus is mounted along the wall opposite to the main bus, with the 4,000-volt switchboards mounted below. The 4,000-volt circuits are brought out of the substation underground.

The physical arrangement of the 4,000-volt distribution equipment in the four-bank substation is somewhat similar, except that two main buses are used and that the auxiliary bus is installed in the basement with hand-operated oil circuit breakers for connecting the circuits to the auxiliary bus.

Land in territories served by the two-bank substations is usually in 25-ft. widths or multiples thereof. This permits the most economical use of a property 100 ft. wide, allowing space on one side, if necessary, for a driveway to handle equipment going in or out of the outdoor substation. Space between the station and an adjoining building for fire protection is also available.

A sealed-type storage battery is installed in each substation to supply the necessary direct current in the same way as in the urban substations. Tungar chargers are used to keep these batteries charged. Electric space heaters are also utilized to keep the stations at a temperature such that condensation will not form on the apparatus. Metal targets similar to those used in urban substations are used to mark individual compartments and designate circuits. Broad red lines are painted between sections to emphasize circuits still further.

Telephones are installed in each substation. However, in the first instance direct private connections are not maintained with the system load dispatcher's office. Provisions are made for this in the future when conditions warrant.

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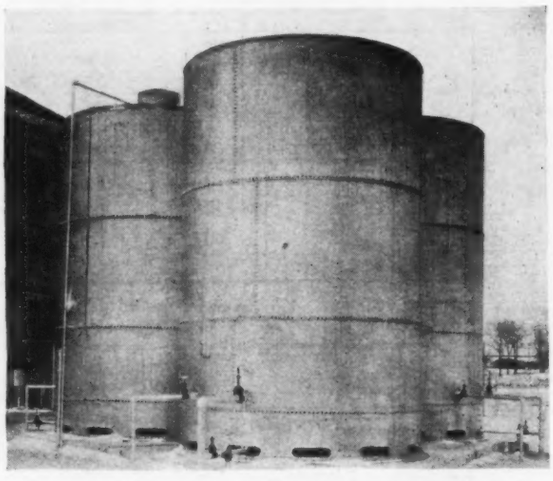
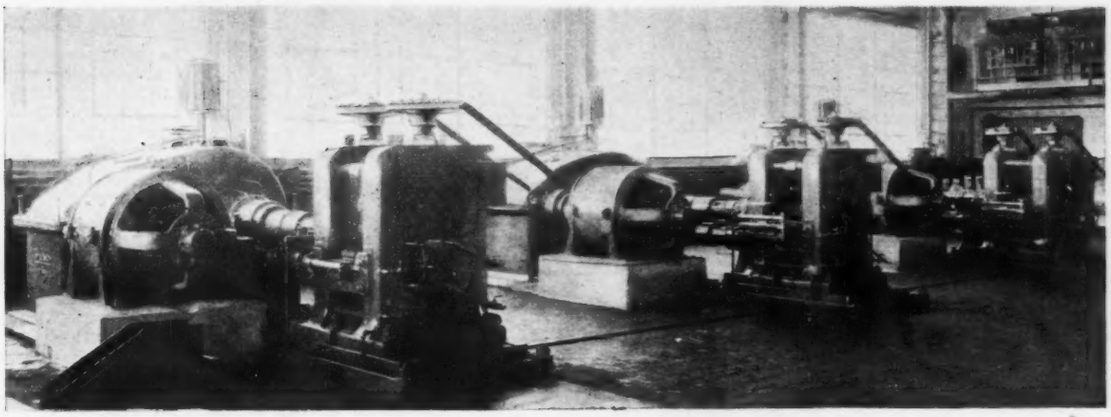
Vertical Oil Storage Tanks Show Economies



Representative of recent practices for substation oil-storage facilities are these three 10,000-gal. steel tanks at the Howard substation of the Ohio Power Company at Vernon, Ohio. Here the containers have been mounted vertically rather than horizontally and carefully grouped. According to Philip Sporn, electrical engineer American Gas & Electric Company, the use of the vertical position means lower-cost tanks, less space for placement, better appearance, easier cleaning and maintenance work and makes simpler the gaging of oil in storage.

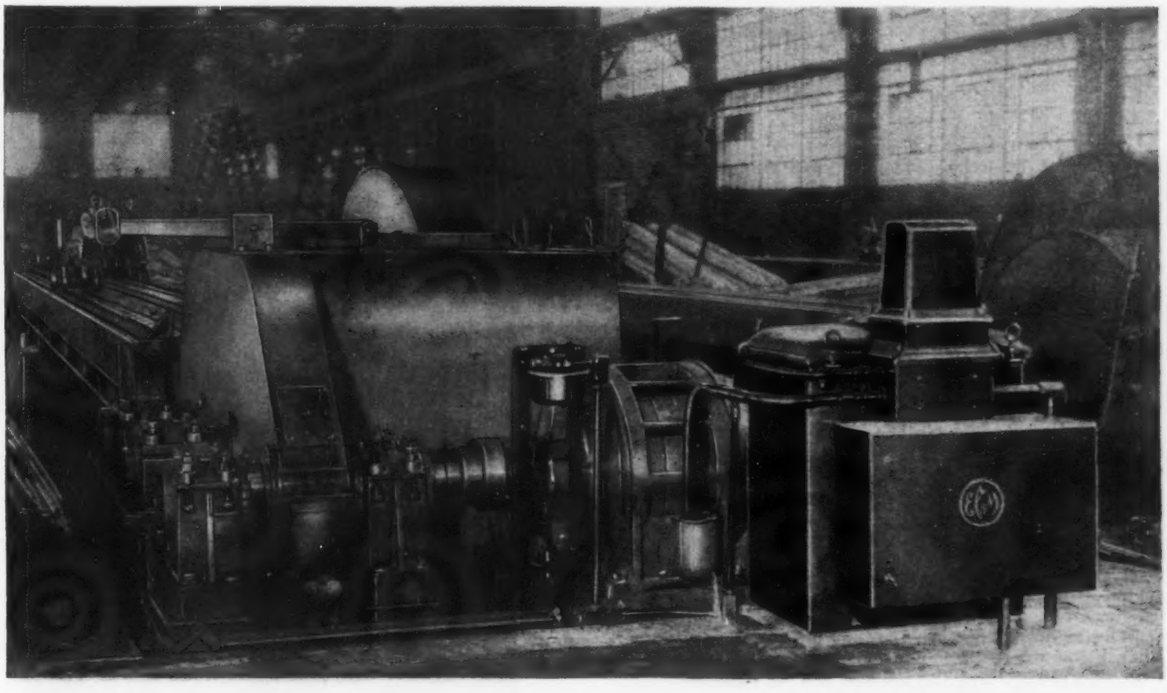
Co-ordinated Drives Eliminate Mechanical Linkages



One great virtue of electric drive that has meant real economy in industrial applications is the ability of the motors to perform in tandem without mechanical linkages. This is shown by these three "Reliance" 150-hp., 400 to 800-r.p.m. motors driving a 12-in. Bliss cold-strip mill. The mill rolls cold-strip steel under tension in sizes from 3 in. up. The motors, having the same speed-load characteristics, permit an extremely simple mill design with consequent economies and advantages.

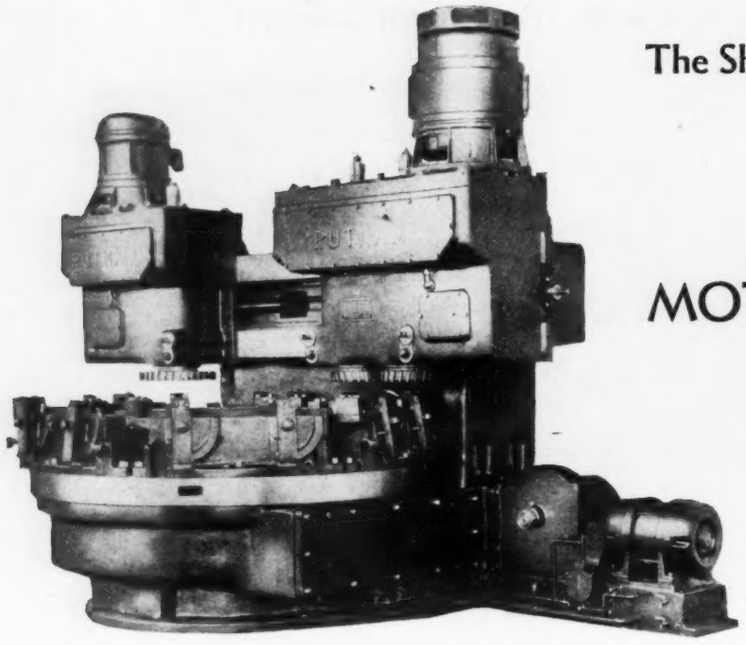
INDUSTRIAL DRIVES FEATURE SIMPLICITY

Conduits and Conductors Minimized by Unit Starter



Two factors of economy commend this starter that controls a 100-hp., 2,300-volt synchronous motor driving a draw bench in the plant of the United States Aluminum Company at New Kensington, Pa. The first is the elimination of the usual control room or inclosing cabinet. The second is that the starter is placed close to the motor and the length of conduit runs and connections is much reduced. The starter was furnished by the Electric Controller & Manufacturing Company completely wired and assembled, ready for connection. As all live parts are wholly inclosed and the case grounded, there is no danger of shock to workmen and service continuity is improved.

MOTORS, CONTROL MEET

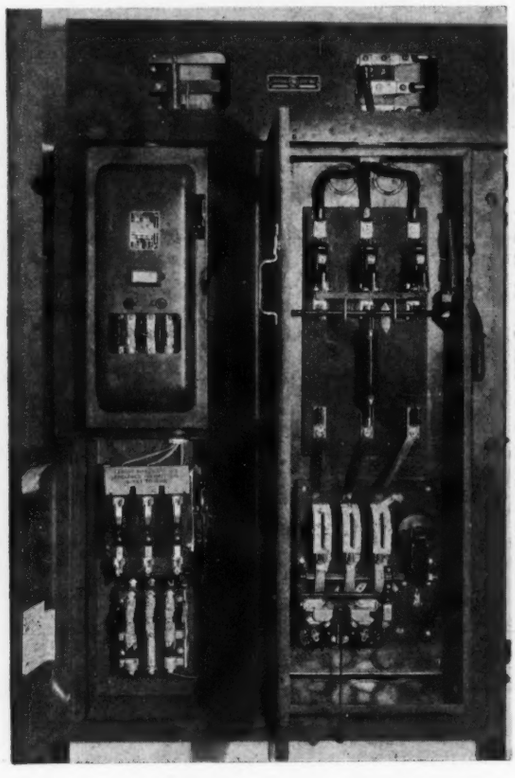


The Short-Length Drive

The modern idea of bringing the power as close as possible to the work—which is, of course, the great advantage of electricity over other power agencies—goes on to its refinements—not only bringing the power to the machine but bringing it right up to the work in the machine itself. This idea is admirably exemplified in this 72-in. rotary continuous-milling machine for production use where large numbers of identical parts are to be turned out.

The machine has three drives, each one as short as the design will permit. It is equipped with "Reliance" fan-cooled inclosed motors. One of 15 hp. drives the double-spindle head, one of 10 hp. operates the single spindle, and the third of 5 hp. drives the table feed. Since this is a production machine designed for continuous operation, the motor duty is exacting, necessitating particularly an adequate provision against excessive temperature rise.

Safety, Simplicity and Lower Cost in Motor Control



Grouping of necessary devices for motor control at one point (thereby reducing the possibility of inexperienced workmen tampering with apparatus), simplicity of installation and consequent lower cost are three advantages of the new-type industrial control board here illustrated. Another feature is elimination of wiring gutters and the possibility of a fault spreading to all circuits where wires are bunched.

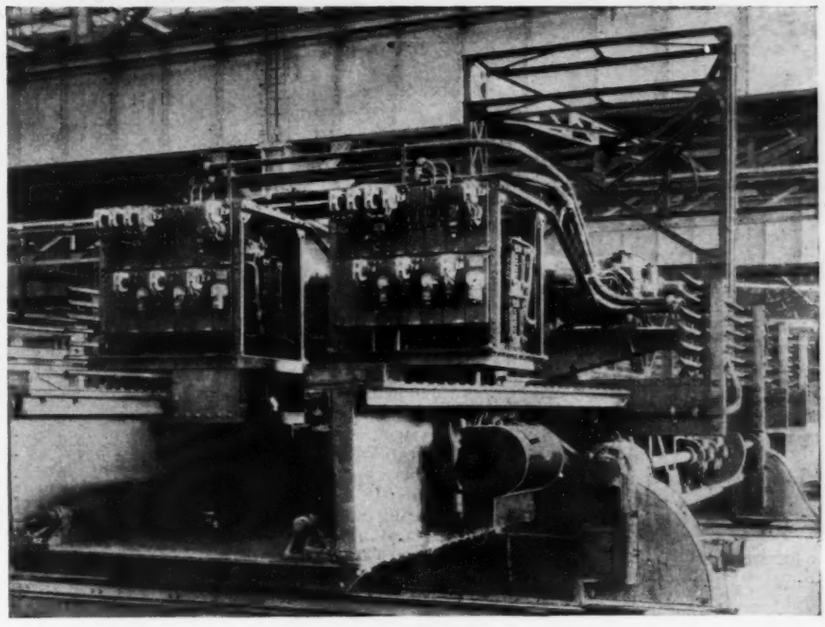
These distribution centers consist of a common bus gutter which is fed from a master switch or circuit breaker, usually mounted elsewhere. From these buses the circuit is split up through smaller fusible safety switches mounted in steel cabinets with interlocked doors. The same cabinets also contain a magnetic switch arranged for push-button control. The push-button station itself may be mounted either in the door of the cabinet or at the motor.

The various units are mounted on a steel panel as shown and are interconnected by the manufacturer, with no live parts or wires exposed either at the front or back of the panel. The switch handles are so arranged that they cannot accidentally be opened or closed by any object bumping against the panel. Each circuit is kept separate from the others, and the devices are so mounted that they can be replaced in a minimum of time from the front of the panel. By use of a changeable fuseholder arrangement only two cabinet sizes are required to cover a motor range of from 0.5 hp. to 50 hp. at 440 volts.

These units were designed by engineers in the Seattle office of the General Electric Company and built in the company's Seattle service shops.

Low Bridge—Heads Down!

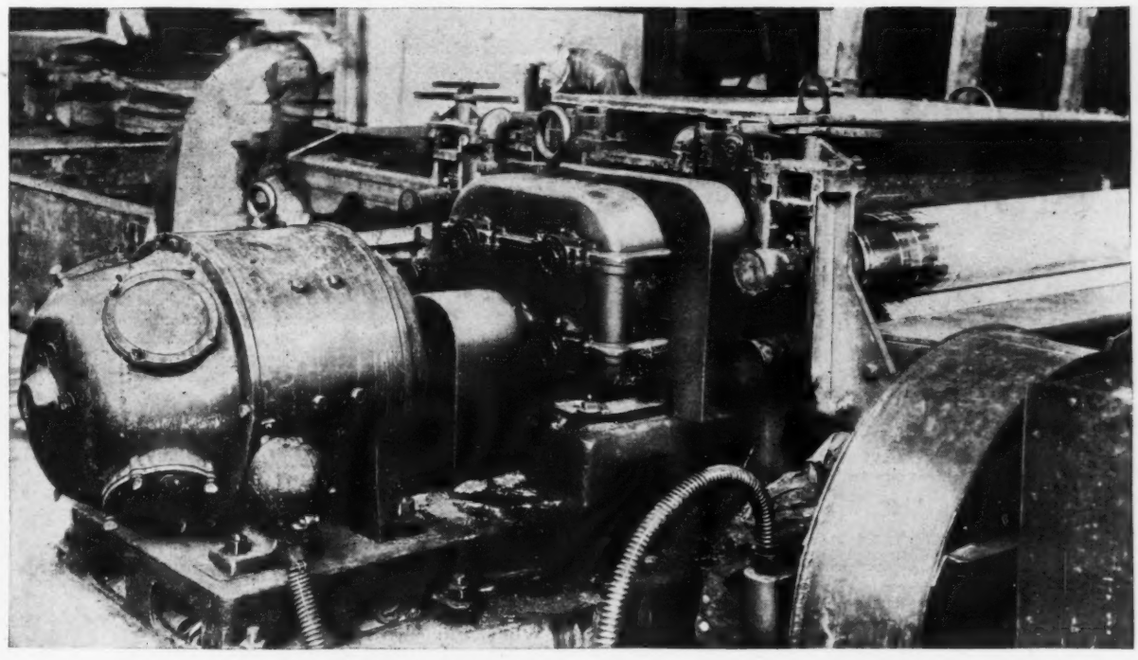
Control panels on this Morgan floor-type charging machine, which is used for handling cars of steel castings on a line of heat-treating furnaces in the plant of the General Steel Castings Company at Eddystone, Pa., would be three tiers high if they followed the usual design.



SPECIAL NEEDS

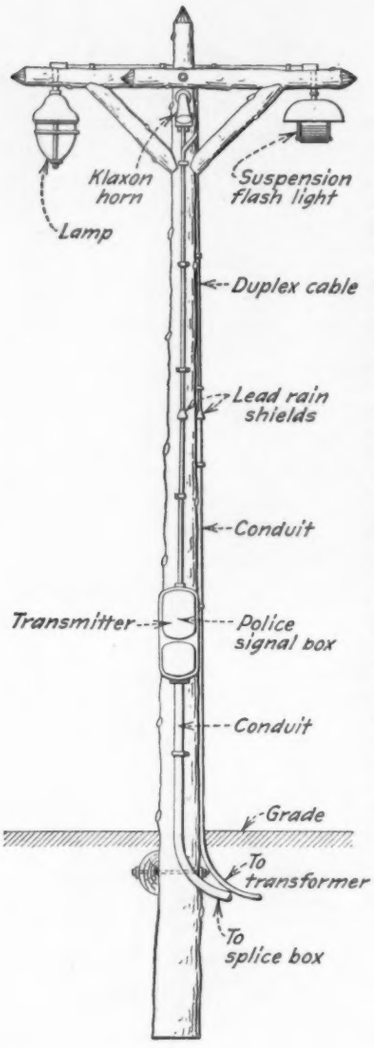
But if they were such a height they would be in considerable danger of damage from being struck by loads moved by the overhead crane. The Electric Controller & Manufacturing Company, whose "Time Current" control device is used in the installation, was thus faced with the problem of designing a board of minimum height, and this involved a considerable revision of the wiring arrangement. There is no better way to insure economy than to take precaution against damage.

An Acid-Proof Application



Because of the splashing acids, with their fumes, dirt and steam, used in cleaning sheet steel an unusually hard application is presented for electric motors driving sheet-steel scrubbing machines. In this cleaning process a large number of steel sheets are bathed in a tank containing strong acids. This loosens the rust and dirt. Then the sheets, one at a time, are passed through the scrubber rolls, where they are made perfectly clean. The scrubber consists of four sets of rolls. The two inner sets have bristles like that of a hand scrub brush. As the sheets pass between these rolls blasts of live steam are played on them to remove all traces of acids. These conditions would mean short life for the windings of ordinary motors. The inclosed watertight construction of the "Reliance" motors used on these machines provides complete protection against acids, moisture and dirt. These motors have a solid bracket for the back end and a solid bracket with hand-hole covers at the front end. The covers are fitted with rubber gaskets. The motors have either ball or roller bearings.

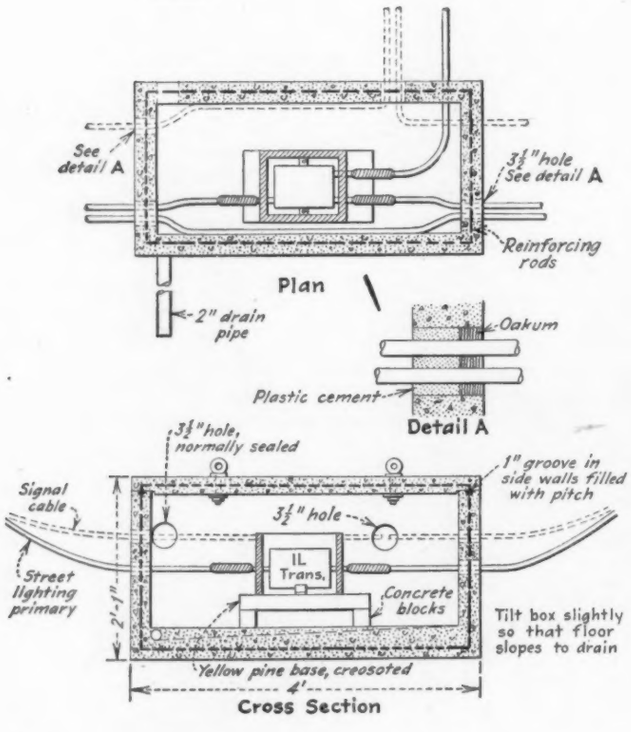
Rough Cedar Poles Support Suburban Lights



Posts, crossarms and braces of native red cedar, with its natural growth of bark and knots, draw favorable comments and preserve the amenities on the Bronx River Parkway, New York City, where they support 19 miles of wire and basket type street lamps. There are about 500 units in this lighting system, each of which has a rating of 4,000 lumens. This type of fixture has proved so satisfactory during several years' use, according to H. W. Watt, electrical engineer Westchester Lighting Company, that it is now being extended throughout Westchester County. Part of these fixtures are combination lights and police signals, which serve the double purpose of providing light and the protection of the law for the people on the parkway.

The current for the lights is supplied through a single-conductor parkway cable, which feeds through precast concrete service boxes, one of which is located at the base of each pole. These boxes are set so that the concrete cover is far enough below the surface to permit a growth of grass.

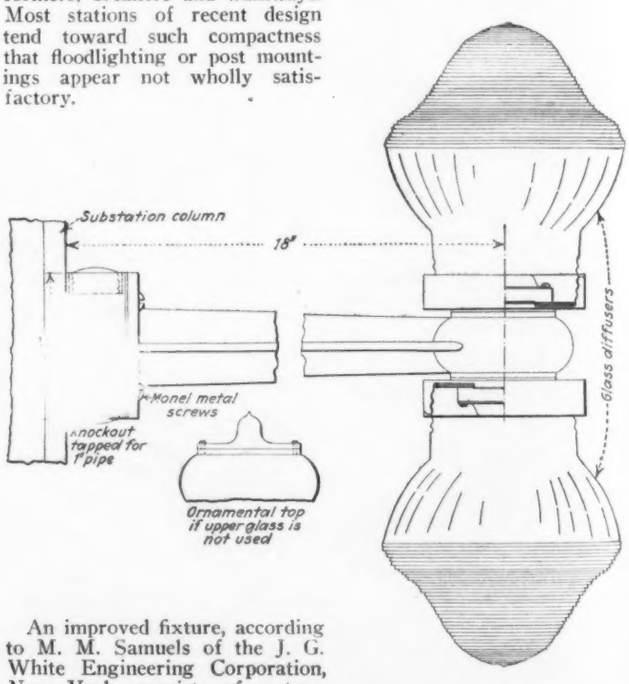
In each box there is an I.L. transformer, and cable from the secondary is carried up the back of the pole in order to supply the unit. In laying the cable for this lighting system a plough was used which cut a ditch 18 in. deep, laid the cable and placed the dirt and sod back in their original position in one operation.



BETTER LIGHTING FOR

Two-Lamp Unit Improves Substation Lighting

Modern outdoor substations require lighting of the upper part of the structure, containing bus work and pole-top switches and other items of equipment, and lower-level lighting of transformers, breakers and walkways. Most stations of recent design tend toward such compactness that floodlighting or post mountings appear not wholly satisfactory.



An improved fixture, according to M. M. Samuels of the J. G. White Engineering Corporation, New York, consists of a two-light bracket and fixture with "Holophane" units directing the light up and down as needed and mounted on substation columns.

Various types of glass can be used in accordance with the required distribution, Mr. Samuels points out, and the complete fixture can be specified by one catalog number, including glass, thus also saving a great deal of time and avoiding many mistakes in the drafting room and in purchasing.

When the upper glass is not required, an ornamental cover is provided to take its place. This fixture is not only suitable for outdoor substations, but for many cases in power houses, such as boiler aisles and industrial plants. The design was developed by the J. G. White Engineering Corporation in co-operation with the Holophane Company.

Control Board Lighting Eliminates Shadows

Ideal lighting conditions from the standpoint of the operator were attained at the new La Fresa substation of the Southern California Edison Company, Ltd., according to H. T. Crane of that organization, in a system which eliminates reflections

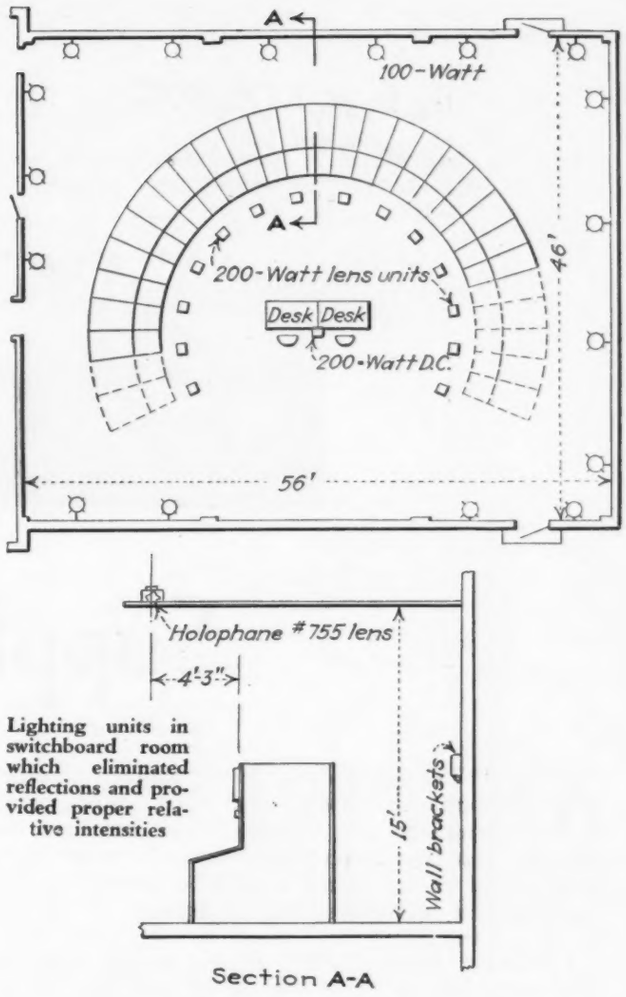
STREET AND STATION

from instrument faces and provides a proper relative intensity on the operators' desks and the switchboard itself. To accomplish this all windows were eliminated from the room and a system of directed lighting chosen.

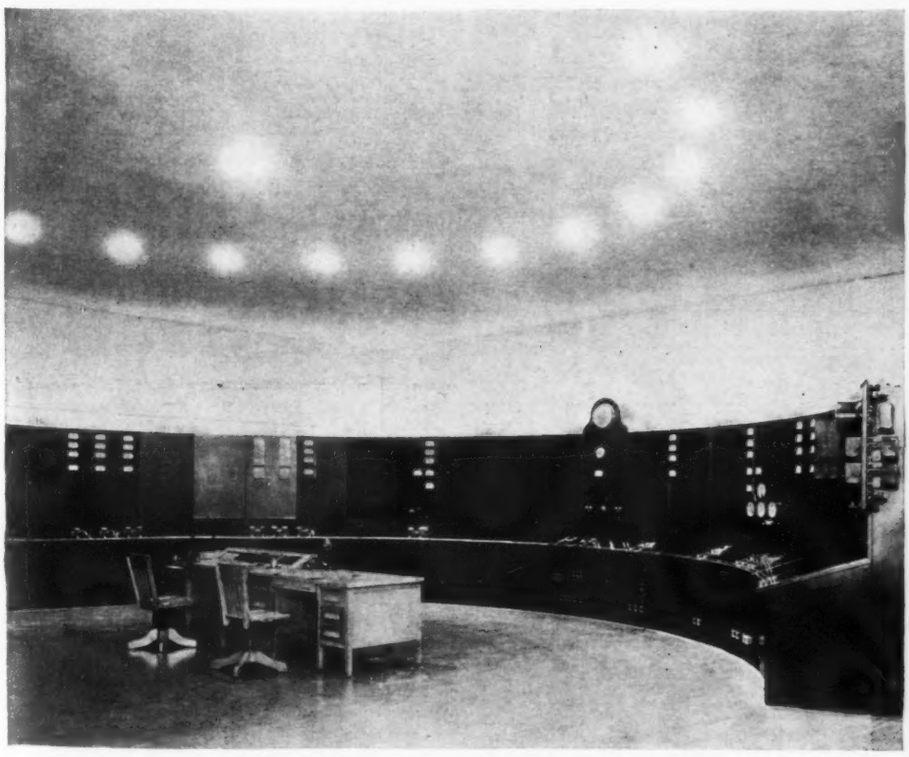
The units consist of "Holophane" No. 755 lenses in a hinged frame set flush with the ceiling, with a "Holophane" No. 2119 reflector and 200-watt clear lamp above. The lamps and reflectors are mounted in an adjustable box, giving control of the beam spread by raising or lowering the lamp and reflector. Control of the beam direction is made by horizontal adjustment with respect to the center of the lens plate. Fourteen units were installed as shown on the accompanying plan and section. Every third unit was wired on the d.c. emergency throw-over circuit and one unit in the center over the desks is allowed to burn continuously on the d.c. circuit.

The beams were adjusted so as just to cover the board, giving the highest intensity where desired and using the spill light and the d.c. unit directly above to light the desks. Semi-indirect bracket lights were installed around the walls of the room to light the rear of the switchboard and to provide general illumination. These throw a soft light on the ceiling and give the room a more cheerful appearance.

Results of the installation have been very satisfactory. Readings taken showed an intensity on the vertical part of the benchboard to be 15 ft.-candles, on the bench part 25 ft.-candles and on the operators' desks 8 ft.-candles. With intensities so proportioned, the operators can look up from white paper on their desks and see the board immediately without having to wait for their eyes to become accustomed to a lower intensity.



Lighting units in switchboard room which eliminated reflections and provided proper relative intensities



Operators in this control room may look up from white paper and read their instruments without waiting for their eyes to become accustomed to a lower lighting intensity

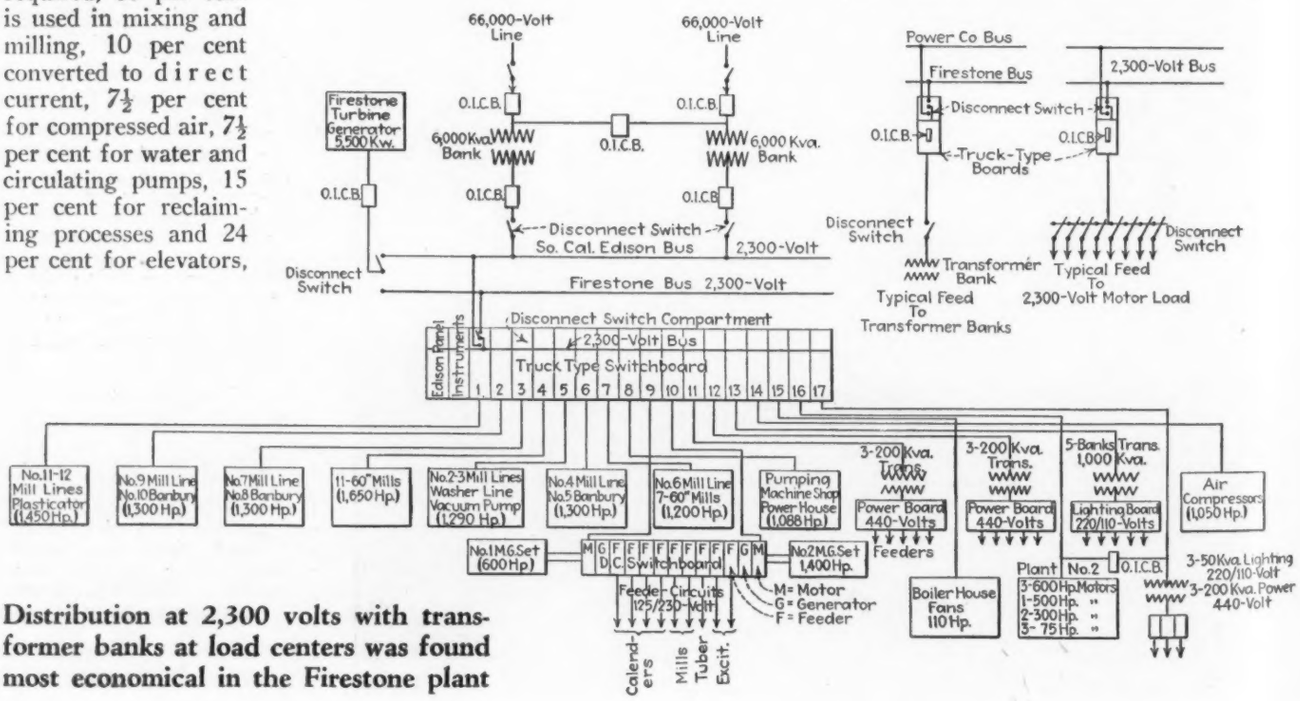
By F. A. ROEHRIG

Formerly with
Westinghouse Electric & Manufacturing Company,
Los Angeles, Calif.

Supply and Distribution f

ADEQUATE and suitable power supply, providing continuity of service free from costly process interruptions, and suitable power and light distribution, resulting in economical use of copper and a minimum of feeder losses, should be among the first considerations in any large industrial plant. At the new factory of the Firestone Tire & Rubber Company in Los Angeles, where 9,000 tires and 15,000 tubes are made daily, careful engineering study was given to the supply and distribution of a 22,000-hp. load in order that all these requirements might be met. Of the total power required, 36 per cent is used in mixing and milling, 10 per cent converted to direct current, 7½ per cent for compressed air, 7½ per cent for water and circulating pumps, 15 per cent for reclaiming processes and 24 per cent for elevators, lighting and heating and small motors employed for miscellanous purposes.

The general scheme employed was to distribute the combined generated and purchased power through a seventeen-panel truck type board in the power plant to the various sections and principal load centers in the factory, as shown by the accompanying schematic diagram. Because of the great area covered by the plant it was found most economical to provide 440-volt power and lighting service by locating transformer banks at load centers and stepping down to service voltage and to



Distribution at 2,300 volts with transformer banks at load centers was found most economical in the Firestone plant

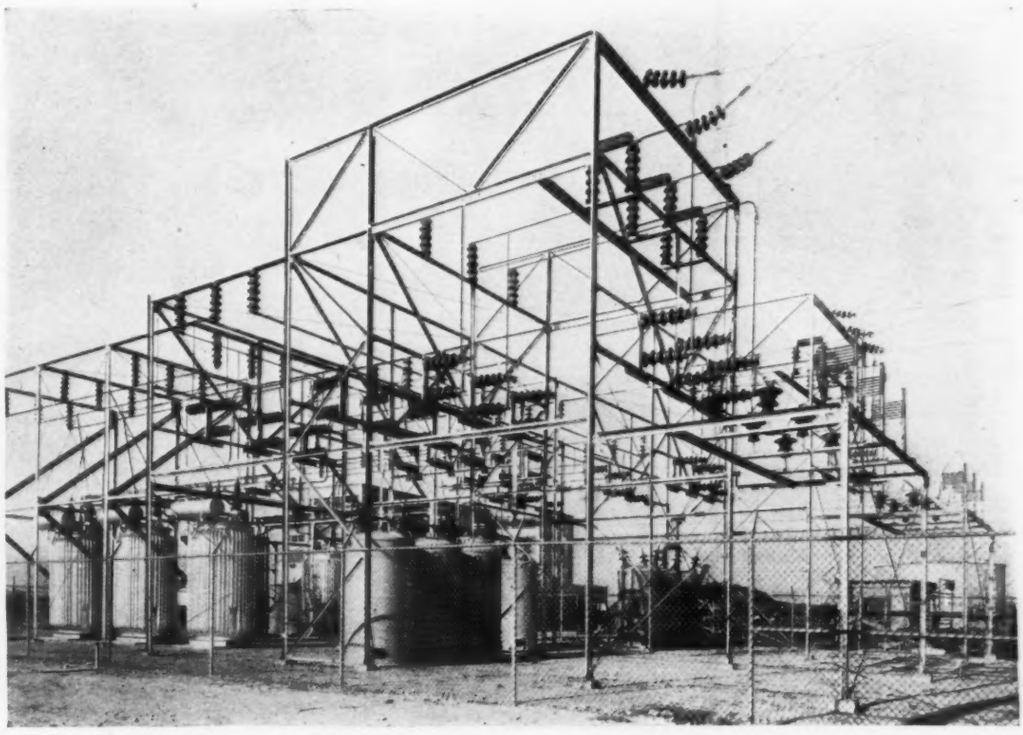
Combined generated and purchased power most economical. Duplicate feed insures continuity of service. 2,300-volt feeders with transformer banks at load centers for 440-volt power and lighting was scheme of distribution employed

n for 22,000-Hp. Industrial Load

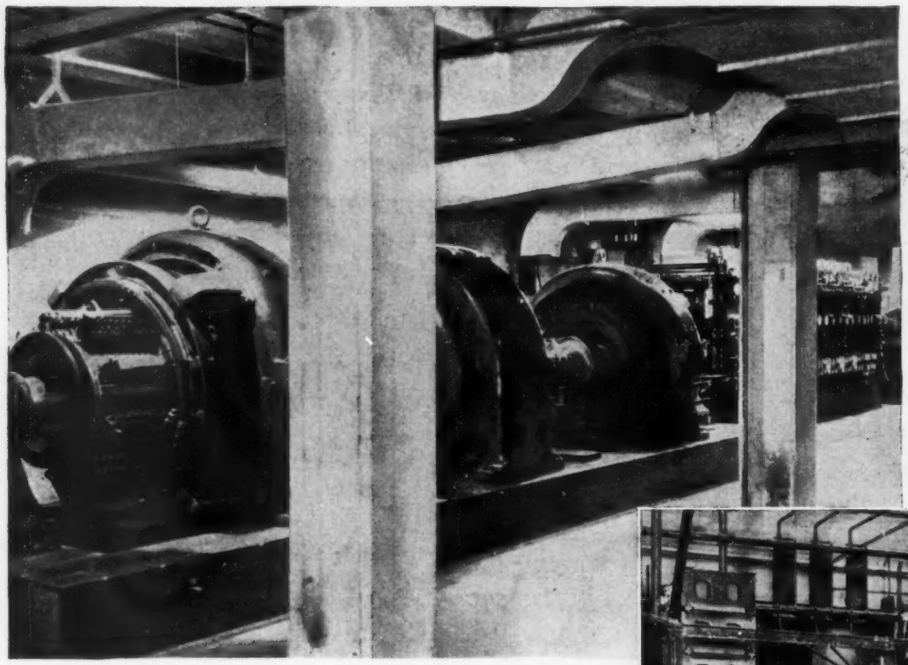
provide direct-current power by generating it at a centrally located substation within the plant.

The plant is supplied with purchased power at 2,300 volts from a substation with duplicate 66,000-volt lines and by generated power from a 5,500-kw. turbo-generator unit. Both sources of power feed onto a double bus with paralleling oil circuit breaker. From this double bus a seventeen-panel truck type board is fed for distribution of power throughout the plant. This arrangement provides a very flexible power control system, permitting parallel operation of the turbo-generator with the power company system. In addition, it permits segregation of the amount of load to be carried by the generator and the power company system as desired. The primary object of using the turbo-generator was because it is the most economical and efficient means of reducing pressure for the large quantities of process steam required.

The truck type board, shown in one of the accompanying illustrations, is ideally adapted to industrial plant distribution because of its flexibility, convenience of operation, safety and appearance. Two panels of this board, together with two auxiliary meter panels, serve

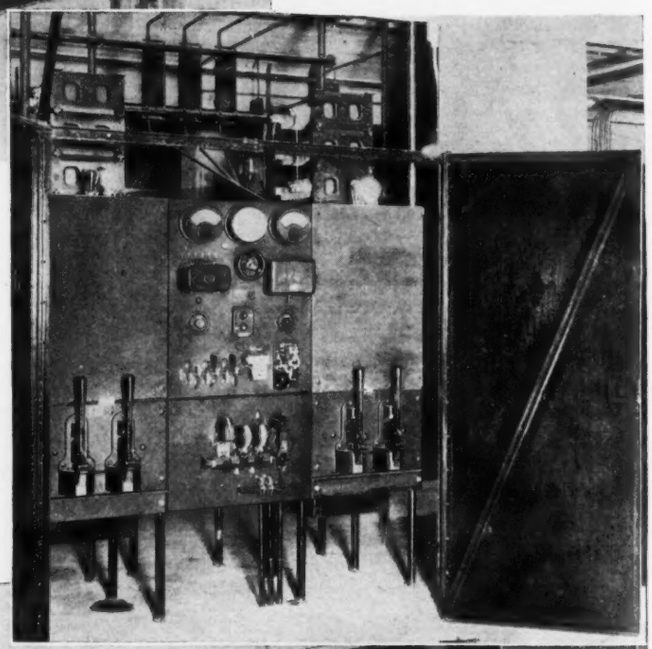


Duplicate transformer banks with two 66,000-volt feeds insure reliable service from this industrial substation

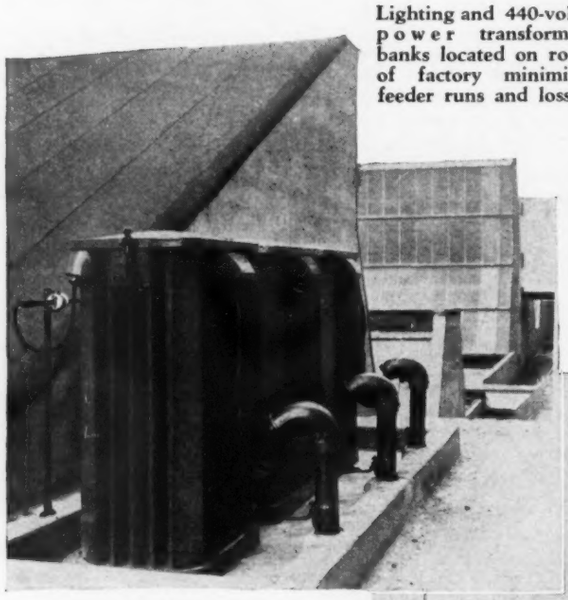


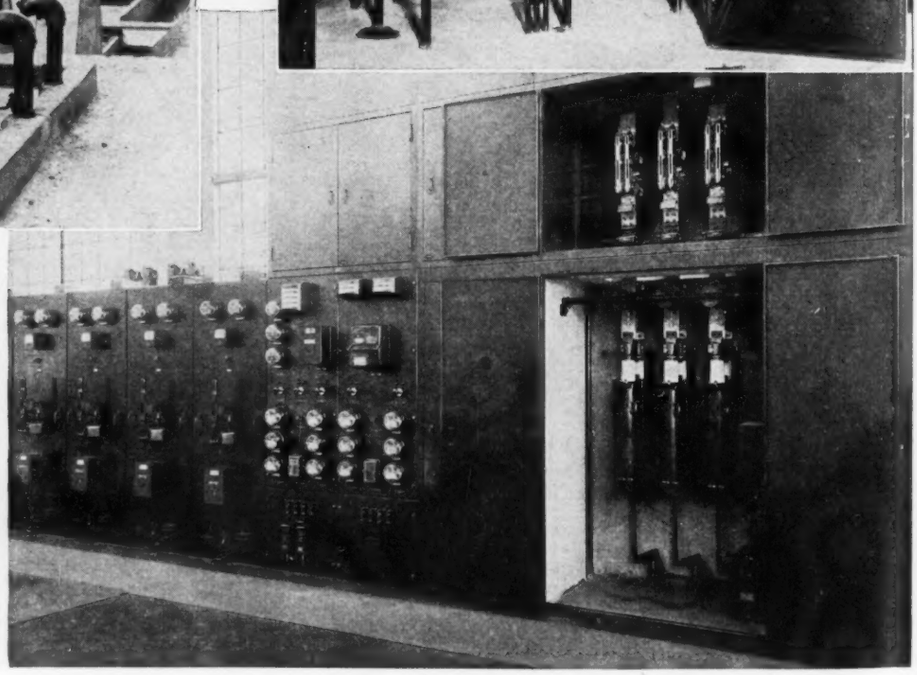
Direct current power was carried to load center by locating motor - generator sets in basement directly below machines requiring d.c. motors

Steel-protected motor-starting panels form an inclosure for motor-generator sets. Floor space was conserved and building costs reduced

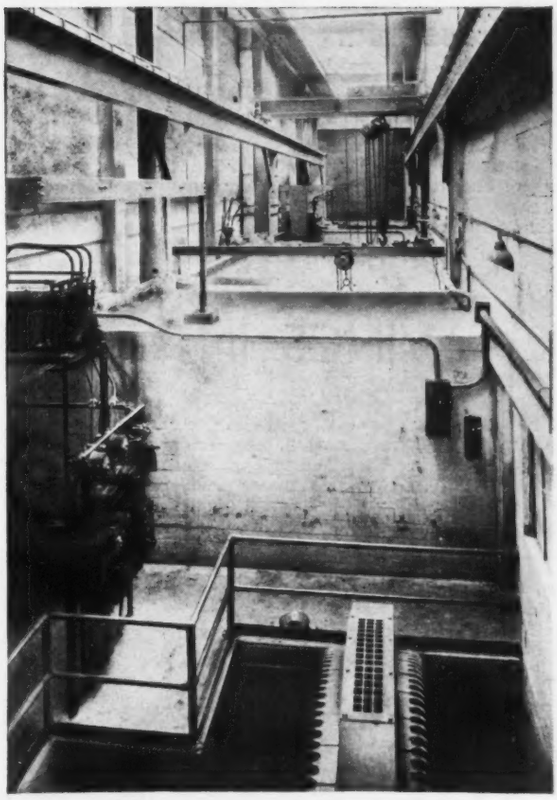


Lighting and 440-volts power transformer banks located on roof of factory minimize feeder runs and losses





Metal - inclosed buses and switches and truck-type feeder boards provide safety and flexibility in serving large industrial loads



Synchronous motors and control panels for mill lines occupy individual pits

to control the output of the turbo-generator unit. Seven panels are used to distribute 2,300-volt power to a total connected synchronous motor load of 15,000 hp. Three panels feed eleven transformer banks, six for 440-volt power with a total load of 2,300 kva. and five for 120-240-volt lighting with a total load of 1,200 kva. These banks are centrally located throughout the plant and are installed on the roof of the building, as shown by one of the accompanying illustrations.

Lighting transformer banks are interconnected on both high and low sides so that the load may be shifted from one bank to another in event of emergency. Sub-feeder switchboards of the dead-front dead-rear type feed from the several control centers and serve further to distribute energy to various sections of the plant.

Manually operated oil circuit breakers are used on the truck type board, each equipped with inverse-time limit overload relays. Each feeder panel is provided with a watt-hour meter, which gives an accurate record of the power consumed in each department and enables the plant manager to keep a close check on production costs, a matter of great importance in any large industrial plant. Suitable 2,300-volt sub-panels and switching equipment fed from the truck type board in the power house are used in different sections of the factory for distribution of centralized group loads.

Direct current is supplied from a substation centrally located in the basement off the main production floor, away from dust and dirt, and so located with respect to the d.c. load center as to reduce feeder runs and losses to a minimum. The bulk of the d.c. power is supplied by two three-unit motor-generator sets, one rated at 400 kw. and the other at 1,000 kw. Both sets are driven by synchronous motors, permitting close voltage regulation on the d.c. generators. Three-unit sets were used in preference to two-unit sets to permit severe unbalanced loads to be imposed on the d.c. system.

A complete switchboard, consisting of thirteen panels, controls the two motor-generator sets and distributes direct current to a total connected load of 3,000 hp. The a.c. panels of this board are fed through two of the truck type panels located in the power house. The direct-current feeder panels distribute power through sub-feeder boards and externally operated switches to their respective loads. Direct-current power requirements are as follows: 40 per cent calendering, 15 per cent milling, 15 per cent tread and tube tubing, 10 per cent stock preparation and 20 per cent miscellaneous small motors, conveyors and excitation.

Synchronous motors are used extensively for mill lines, mixers, motor-generators, air compressors and pumps and comprise more than half the total load in the plant. This type of load requires a minimum of copper and provides a plant power factor close to unity in anticipation of a substantial bonus or discount on purchased power. Power-factor control is accomplished by operating with predetermined field on the synchronous motors within the plant and properly varying the field on a 500-hp. synchronous motor driving an air compressor in the power plant. Occasional adjustment of the field on this motor keeps the power factor of the total load at unity. Feeder losses are thus kept at a minimum and the 5,500-kw. turbo-generator may be operated at full power rating.

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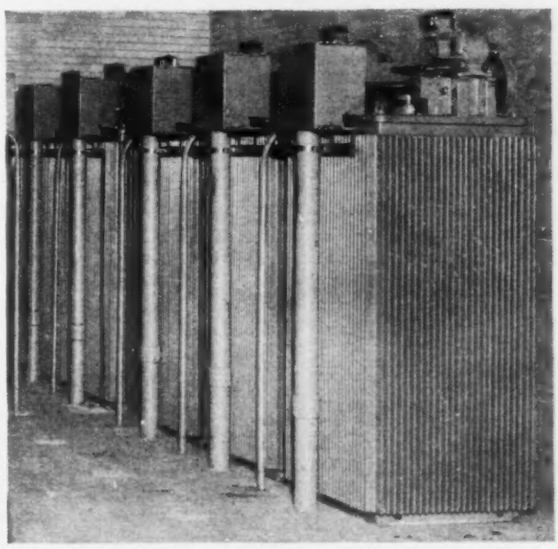
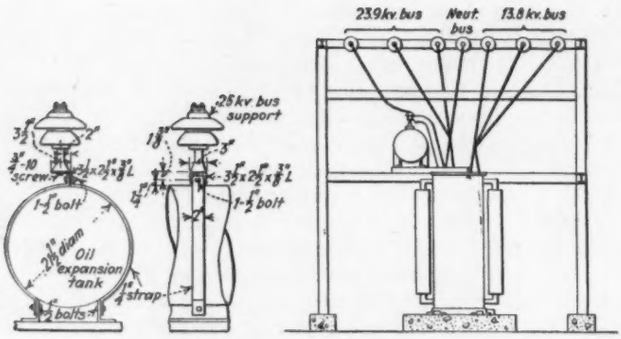
Pull Boxes Improve Regulator Installations



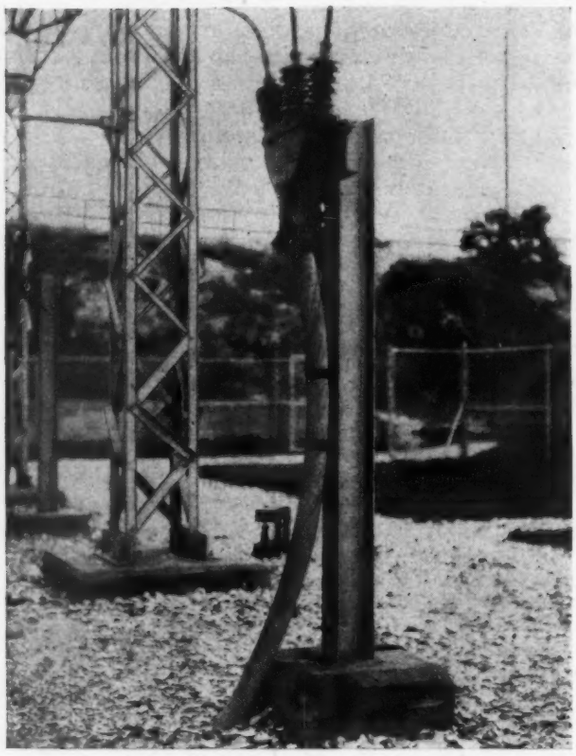
Provision of a pull box on the top of the conduit that carries conductors to the 4,000-volt, single-phase regulators used on the distribution system of the Commonwealth Edison Company, Chicago, provides a convenient place for terminal connections and greatly improves the appearance of substation installations. The box fits over the top of the regulator case where the leads emerge from it.



Conservators Need Not Limit Substation Design Economies

Oil conservator tanks sometimes interfere with the direct runs of transformer connections and to some extent dictate transformer positions in, or the design of, substation structures. Drafting the conservator into the design as a conductor-supporting element may, as in this installation of the Northern States Power Company at its new Granite Falls (Minn.) generating station, help toward compactness and simplicity. Two 2-in. x ¼-in. iron straps bolted at the bottom to the conservator feet meet at the top of the tank and hold a small angle piece on which the insulator pin is set.

Underground to Overhead

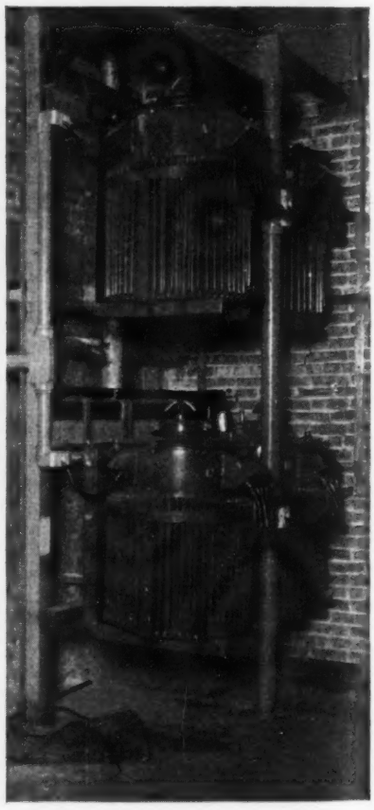


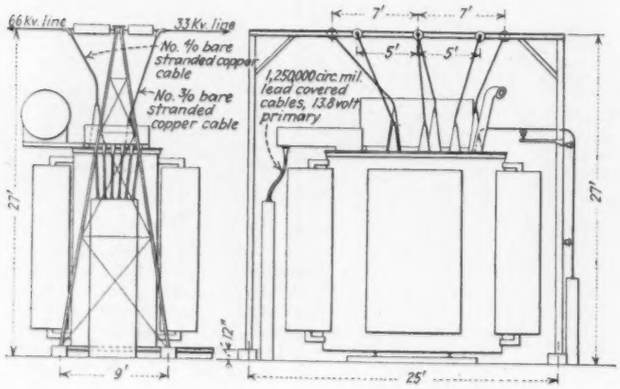
An I-beam set vertically in a concrete foundation and a horizontal cross-bracket of channel shape provide a rigid and simple support for a 22-kv. submarine No. 00 cable pothead from which aërial leads are carried to a switching structure near by.

SAVINGS IN GROUPED

Cross-arm Construction Saves Space in Substation

A double-deck transformer bank using distribution-type transformers for station supply in the Vernon Park substation of the Commonwealth Edison Company, Chicago, permits of a distinct space saving. The hangers are fixed on a steel rack exactly as on a pole cross-arm. This also proved to be an economical type of construction.





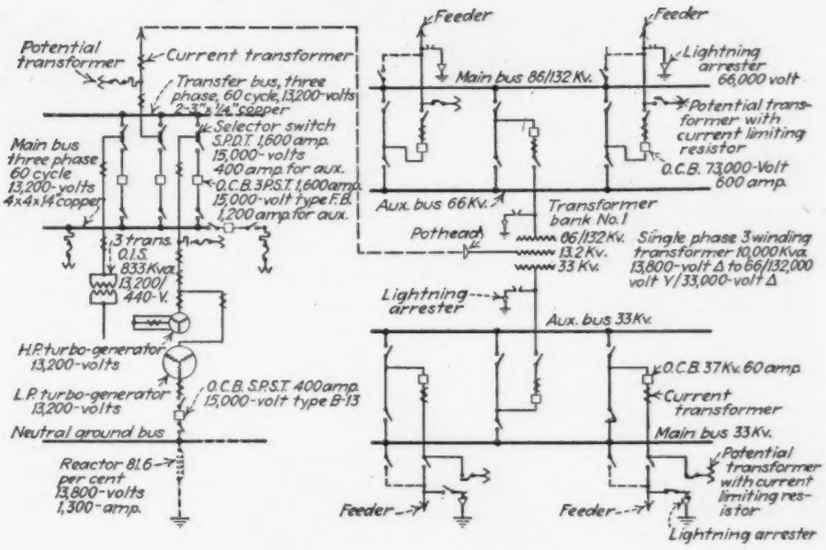
Steelwork Minimized in Outdoor Substation

Two A-frames, held at the top with a single cross member, make an adequate transformer structure if the right type of transformer is used. It would be difficult to adopt such simplicity with a bank of single-phase units, but this 30,000-kva. installation, stepping up the generator voltage of 13.8 kv. to line potentials of 33 kv. and 66 kv. at the Belle Isle generating station of the Oklahoma Gas & Electric Company, involves three-phase transformers and has been successfully developed.

Three-Winding Transformers Used at South Amboy

EQUIPMENT

The new South Amboy (N. J.) steam station of the Jersey Central Power & Light Company supplies 33-kv. and 66/132-kv. transmission lines through a bank of three-winding transformers from the primary voltage of 13.2 kv. The transformers are connected to the generators by three 750,000-circ.mil impregnated, paper-insulated, lead-covered type H cables to the 13.2-kv. double bus system. The generators can be connected to either of the 13.2-kv. buses and flexibility is further secured by oil switches on the 33- and 66/132-kv. sides. Transformer primaries and secondaries, as well as all lines, are protected with "Thyrite" lightning arresters.

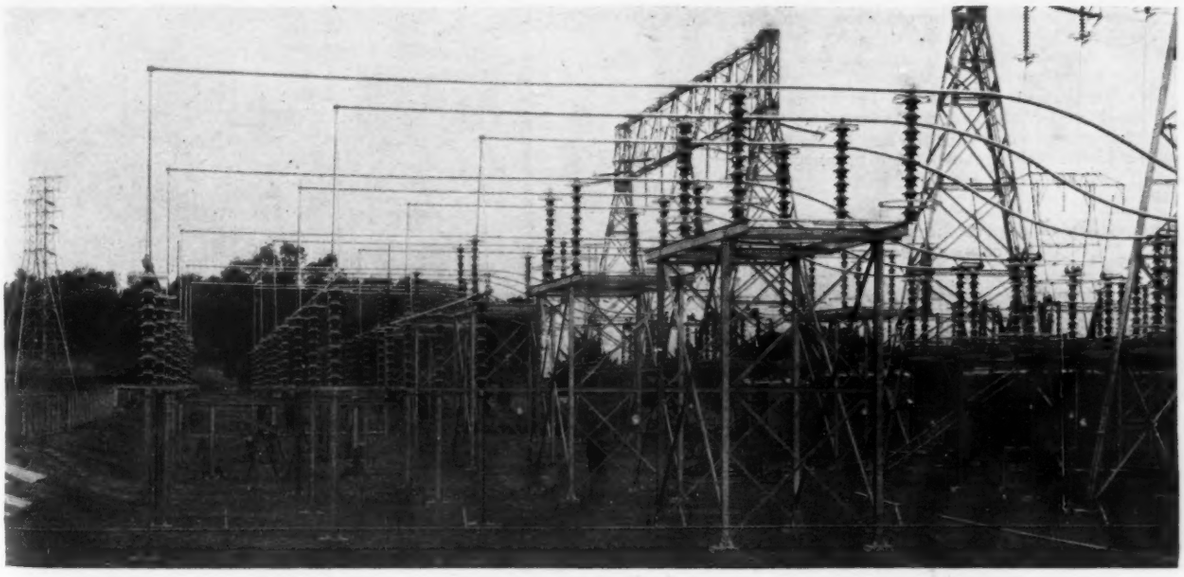

Potential transformer
Current transformer
Transfer bus, three phase, 60 cycle, 13,200-volts 2-3"x¼" copper
Selector switch S.P.D.T. 1,600 amp. 15,000-volts 400 amp. for aux.
O.C.B. 3 P.S.T. 1,600 amp. 15,000-volt type F.B. 1,200 amp. for aux.
Main bus three phase 60 cycle 13,200-volts 4x4x¼ copper
3 trans. O.I.S. 833 Kva. 13,200/440-V.
H.P. turbo-generator 13,200-volts
L.P. turbo-generator 13,200-volts
O.C.B. S.P.S.T. 400 amp. 15,000-volt type B-13
Neutral ground bus
Reactor 8.16 per cent 13,800-volts 1,300-amp.
Feeder
Feeder
Lightning arrester 66,000 volt
Main bus 66/132 Kv.
Potential transformer with current limiting resistor
O.C.B. 73,000-Volt 600 amp.
Aux. bus 66 Kv.
Transformer bank No. 1
Pothead
66/132 Kv.
13.2 Kv.
33 Kv.
Single phase 3 winding transformer 10,000 Kva. 13,800-volt Δ to 66/132,000 volt Y/33,000-volt Δ
Lightning arrester
Aux. bus 33 Kv.
O.C.B. 37 Kv. 60 amp.
Current transformer
Main bus 33 Kv.
Potential transformer with current limiting resistor
Feeder
Feeder
Lightning arrester

Tubular Aluminum Buses Eliminate Bus Tap Splices

Tubing has been used almost exclusively for bus construction at the Roseland switching station of the Public Service Electric & Gas Company of New Jersey. For 132-kv. service copper tubing of 3½-in. outside diameter has been used, and for 220-kv. service aluminum tubing, 5 in. in outside diameter, has been the material employed.

This is the first use of aluminum for high-tension tubular work, according to H. J. Glaubitz of United Engineers & Construction, Inc., the organization which designed and built the station, and this metal was chosen largely because it could be obtained in long lengths (45 ft.), permitting the elimination of splices in bus taps.

A semi-flexible method of making bus taps has been adopted which is quite different from the rigid connection for which most companies strive. While the bus tap is securely held statically, the slenderness of the legs of the "A" frame (1¾ in. outside diameter, 15 ft. high), shown in the accompanying illustration, allows sufficient movement to the buses to take care of expansion and contraction due to temperature changes. In splicing the main aluminum buses the ends to be spliced were shrunk on a short tubular dowel which had been cooled by being filled with "dry ice." The tube ends were heated just prior to the insertion of the dowel, but only slightly, in order to avoid changing the physical constants of the special aluminum alloy. The excess of outside diameter of the dowel over the inside diameter of the tubing was generally 0.004 in.



Remote-Control Substation Aids Neighborhood Amenities

Substations in residential sections are often problems for the design engineer who recognizes the desirability of avoid-

ECONOMIES IN

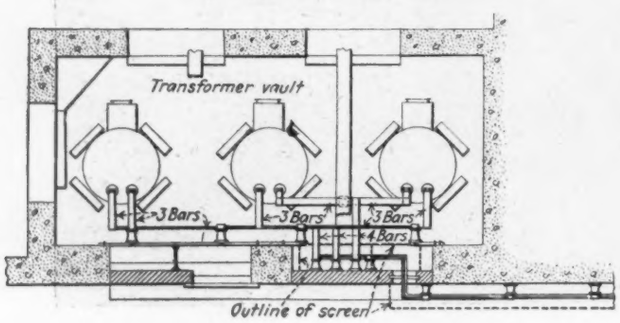
ing appearances that might offend the community yet who knows that greatly increased building costs are to be avoided. It often proves to be the case that to achieve a pleasing appearance at reasonable cost is a problem for the architect rather than the engineer. How well it can be solved is shown by this remote-control substation of the Commonwealth Edison Company, Chicago, erected in a residential district.

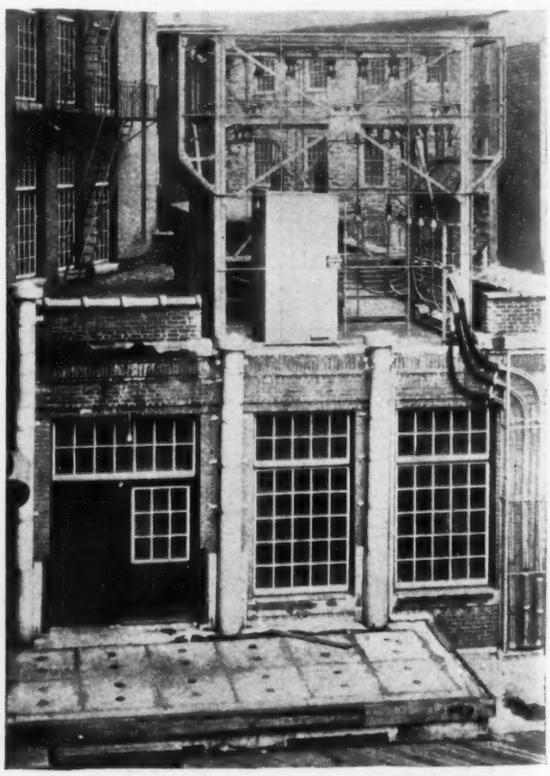
Substation Split Between Basement and Roof

Space limitations in a Woonsocket, R. I., mill required the engineers of the Blackstone Valley Gas & Electric Company to divide the substation layout serving this establishment into roof and vault sections when designing the power installation. This industrial substation has a transformer capacity of 1,500 kva., stepping down the voltage from 13,800 to 230. Energy enters the substation via underground cables made up of three-conductor, 350,000-circ.mil sections, with $\frac{7}{32}$-in. paper insulation, $\frac{7}{32}$-in. paper belt, and lead sheathing. From the potheads the cables are connected with the high-tension switching equipment on the roof. The power transformers, in three units, had to be located in a vault under a loading platform in front of the building, the vault occupying an inside space of 22 ft. x 9 ft. 6 in. x 9 ft. Twelve removable precast concrete slabs, each 4 ft. 2 in. x 3 ft. 7½ in. x 4 in. and weighing 700 lb., cover the transformer vault and facilitate handling for maintenance of repairs.

Ventilation is provided by windows in the wall under the loading platform, 14-in. discharge pipes carrying the heated air to the roof. A 15-kv. 600-amp. oil circuit breaker is mounted in a sheet metal housing on the roof. The secondary buses are of 4 x ¼-in. copper bar construction, screened for safety in their course from the substation into the mill proper.

Secondary leads from basement transformer bank are formed by copper bus assemblies



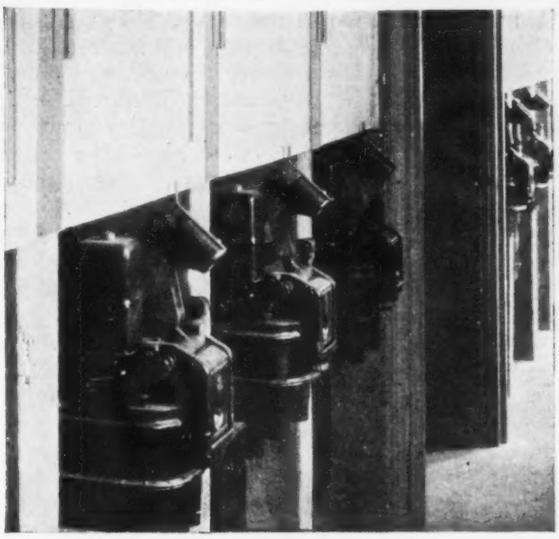


Outdoor bus structure and cable risers screened for protection

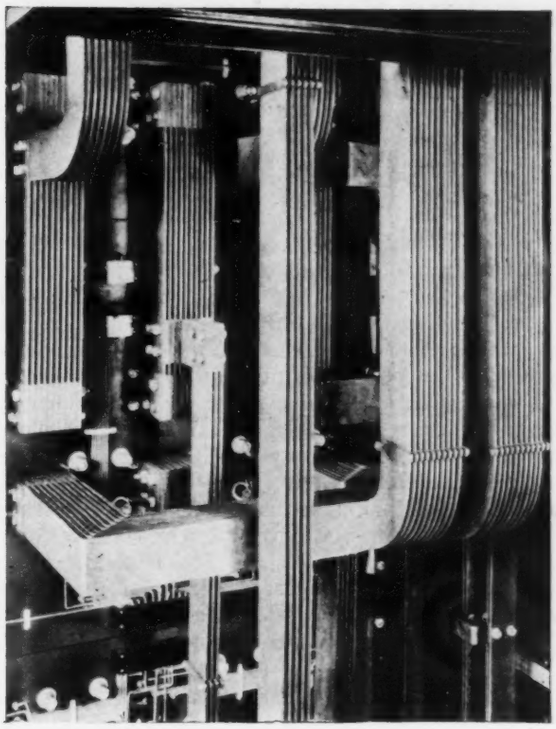
PLANNING DETAILS

Inexpensive Interlock for Bus Compartments

To prevent the opening of compartment doors while the disconnecting switches inside are carrying load is not always a complicated matter. This simple interlock with the oil breaker in the Vernon Park substation of the Commonwealth Edison Company, Chicago, consists merely of a bent metal strip held with



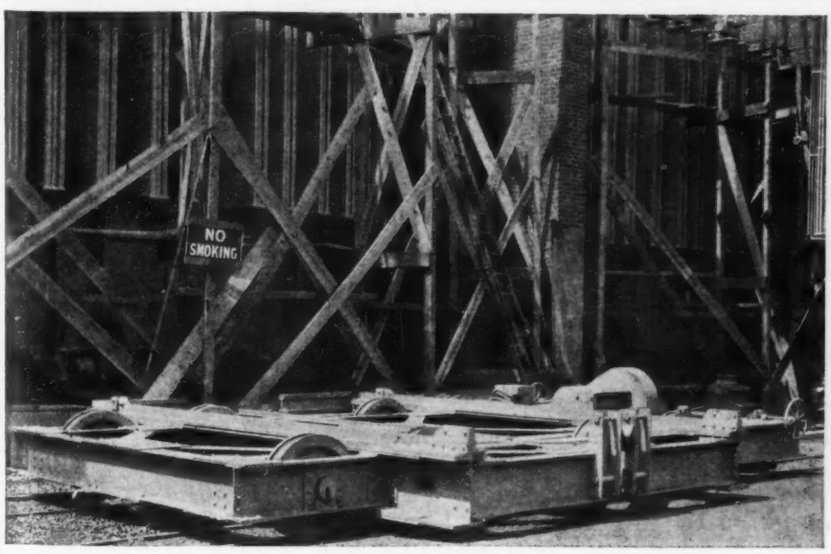
a couple of screws on the top of the operating handle socket. When the switch is open the socket is down and the door may be opened.



Bus Construction Improved by Edgewise Bends

By installing heavy copper connections, utilizing edgewise bends, the number of joints in bus structures may be materially reduced and contact problems and uncertainties minimized. Recent studies by Messrs. Bern and Specht, switchgear engineering department, General Electric Company, have been directed toward improvements along this line. This installation is on a direct-current switchboard in the Western Union Building, New York.

Transformer Handling Speeded by Electric Car Winches



So carefully planned are apparatus-handling procedures at the Roseland switching station of the Public Service Electric & Gas Company of New Jersey that a 220/132/11-kv., 33,000-kva. transformer weighing 300 tons can be disconnected, taken out of a bank, be replaced by another and this latter connected within an hour.

The transformer cars used for this work are equipped with electrically operated double winches, one of which serves to pull the car along by means of a cable quickly hooked to the track or unhooked, while the other winch is used to pull the transformers on or off the foundations. Energy is supplied from various convenient plug connections along the track to a self-reeling extension cable on the car. The cars, or rather their power winches, are often used for general purposes around the station at points not too far from the tracks.

Building Rural Lines for $1,300 per Mile

By S. C. MURRAY

Superintendent Construction,
Associated Gas & Electric System, Binghamton, N. Y.

ELECTRIFICATION of farms has become one of the major construction activities of the various utilities in the past few years. However, because of the scattered population and the low revenue per mile of line, ways and means of cutting the cost per mile are important, if this business is to be served at a profit.

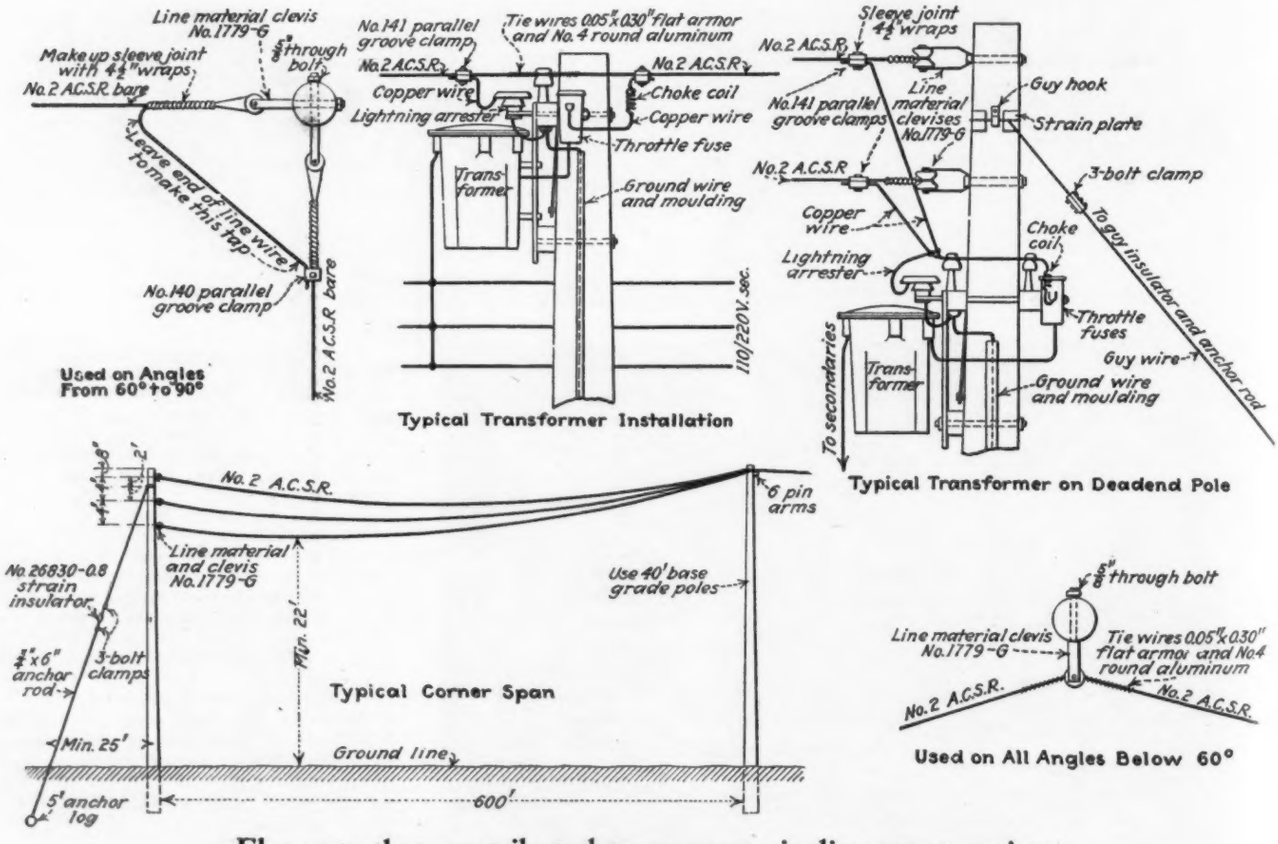
The minimum revenue allowed per mile of line under our existing rates is $288 per year. Applying the usual ratio of 5 to 1 allows only $1,440 per mile of line for construction purposes. It was obviously impossible to construct lines for this figure under our old standards of construction, using weatherproof wire with 30 or more poles per mile, log anchors, etc. It was seen at once that in order to reduce the cost fewer poles per mile must be used, and after considerable experiment No. 2 A.C.S.R., with an average span of 400 ft. using 40-ft. poles, was decided upon.

The old-fashioned custom of shortening spans adjacent to corners received much consideration, and it was found that by using vertical construction with an insulator and clevis attached directly to the pole sufficient strength could be developed and ideal guying facilities made available. It was also found that by installing the anchor with sufficient lead it was not necessary to use a log anchor and by substituting the cone type considerable saving in labor could be effected.

Economies were also effected in obtaining right-of-way, laying out the line and in the location of the line itself. It was found that the new-business man, when signing applications, could at no additional cost obtain the rights-of-way, thus doing away with the necessity of having the right-of-way department add to the expense of the line by sending out a man and a car for that purpose. It was obvious that if the line could be located away from the highway on private right-of-way much could be saved in tree trimming, and also future maintenance. It was found that economies in surveying rural lines could be effected by sending one experienced man allowing him to hire additional help as needed.

Upon the completion of the survey, the possession of all right-of-way requirements, state highway and railroad permits and a reasonable number of consumers ready for service, actual construction of the line is started. A foreman is sent from the main office with a small truck equipped with digging tools. With local labor this man digs a hole and anchor holes, gains and frames the pole and delivers poles at the hole. When a sufficient number of holes is ready a truck with pole-raising equipment is sent to him to do the actual placing of the poles. After the poles are placed a small line crew is sent, which places the wire and hangs the transformers.

By using these methods it has been possible to decrease the cost per mile of line from $2,000 to as low as $1,300 without sacrificing the mechanical or electrical strength of the line.



Elements that contributed to economy in line construction

Men of the Industry

A. D. Dudley Named President of Syracuse Utility

A. DEAN DUDLEY, who was elected president of the Syracuse Lighting Company, Inc., Syracuse, N. Y., as announced in the September 20 issue of the ELECTRICAL WORLD, has been identified with that utility since 1907, when he was appointed commercial manager. He was elected treasurer and assistant secretary in 1918 and a year ago assumed the duties of vice-president. Mr. Dudley was formerly identified with the United

Gas Improvement Company in Philadelphia, where he spent five years in promotional and investigation work. When the U.G.I. interests took over the Syracuse properties he went to Syracuse.

Mr. Dudley has also been prominent in industrial and financial affairs. He is a founder and chairman of the Lincoln National Bank and Trust Company and chairman of the industrial fund of the Chamber of Commerce. He is also a director of the Cortland County Traction Company.

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WILLIAM DEANS, formerly chief engineer of the Sundh Electric Company, Inc., Newark, N. J., has been appointed general manager of that organization. Mr. Deans has been connected with the Sundh Electric Company since 1918 in charge of engineering, including design, development and experimental work. At the same time he has had some responsibility for sales and management. Early in his career he engaged in academic work on the electrical engineering faculty at Cornell University, his alma mater. From 1914 to 1917 he conducted laboratory, design and theoretical courses and from 1916 to 1917 he assisted Professor Karapetoff in his course in engineering mathematics. His teaching job permitted him to use the summer for other work and he spent two summers with the Electric Cable Company at Bridgeport, Conn. In 1917 and 1918 Mr. Deans was a member of the personal staff of Thomas A. Edison at his laboratory in West Orange, N. J., where he devoted his time to research and experimental work. Then followed his connection with Sundh Electric. Mr. Deans is a fellow of the American Institute of Electrical Engineers and secretary of the industrial control section of the National Electrical Manufacturers' Association.

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GEORGE E. BIERWIRTH has been appointed director of safety for the Twin State Gas & Electric Company, with headquarters at Bennington, Vt. He will cover the entire system in both New Hampshire and Vermont in this connection. Mr. Bierwirth has been with the Twin State organization since 1926, serving in various capacities in the line department.

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MORRIS STONE, mechanical engineer with the Westinghouse Electric & Manufacturing Company, has been made the recipient of the second award of the Benjamin Garver Lamme scholarship. The scholarship provides one year's advanced study at any college or university in America or abroad. A graduate of Harvard University, Mr. Stone has been associated with the Westinghouse company since 1925. He is the author of several original treatises specializing in problems dealing with the mechanical aspects of electrical engineering.

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FREDERICK A. STOUGHTON, president of the St. Lawrence County Utilities, Inc., and the St. Lawrence Valley Power Corporation, has resigned, effective November 1. Mr. Stoughton has been in Potsdam for sixteen years. Formerly he was connected with the Aluminum Company in Shawinigan Falls, Que., and for nine years was head of that organization at Massena, N. Y. His other connections include membership on the directorate of the Peoples Bank of Potsdam, the Massena First National Bank and the Ogdensburg Trust Company. He plans to spend some time in visiting European countries.

S. W. Stevens New Vice-President at Springfield

AT A MEETING OF THE board of directors of the United Electric Light Company, Springfield, Mass., Sidney W. Stevens, formerly manager of the company, was elected a member of the board of directors and also to the position of vice-president, to fill the vacancy created by the recent death of Lorenzo J. Scott. A native of Springfield, Mr. Stevens' first connection was with the Loring-Axtell Company in 1905 and part of

1906. From that position he entered the employ of Swift & Company, where he remained until November, 1907, when he began his duties with the United Electric Light Company as meter reader and collector. He was appointed assistant manager in May, 1920, and in October, 1928, became manager of the company.

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OBITUARY

JOHN L. ESSON, vice-president of Ford, Bacon & Davis, Inc., engineers, New York, died suddenly at his home in the Hotel Navarro in his fifty-third year. Mr. Esson entered the engineering field 23 years ago and became well known as a business consultant. A native of Glasgow, Scotland, Mr. Esson removed to America at an early age.

Financial and Statistical News

REDUCED power output is the Street's explanation of recent weakness in utilities stocks. Output figures are actually but 3 per cent under the abnormally high 1929 figure, but are still 6 or 7 per cent over 1928 totals, an excellent example of the ease with which professionals "work" a market as sensitive as the present one.

——INSTEAD OF THE PREDICTED AND USUAL RISE IN TIME MONEY rates at this season, cheap money continues and the call rate is maintained around 2 per cent.

——BUSINESS INDEXES BEGIN TO SHOW AN UPWARD, if but fractional, turn. Raw material buying is extending beyond immediate requirements, Secretary Lamont finds.

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August Revenue Promises Modest Gains

ELECTRIC LIGHT AND POWER COMPANY earnings for August are expected to show an increase of about 2 per cent this year over last, judging from a preliminary analysis of returns received by the ELECTRICAL WORLD. Thus far these cover a third of the industry and afford a fair cross-section of it. The gain may be somewhat less, depending on returns yet to be received. It is not likely to be larger. The corresponding increase in July was 2.5 per cent.

At that, the revenue of the industry may not be far from normal; last year it was over 5 per cent above the normal for that month, so that even a slight rise will bring it close to the new normal, which is about 7 per cent higher.

With more than half the business in the Middle Atlantic States reported, this section shows a rise of 5 per cent. About the same rate is indicated in the Southwest and on the Coast; somewhat less in the Southeast. The industrial area of the upper Mississippi Valley, as in other recent months, is below last year's level. Total energy sales of the reporting companies are lower than last year by 5 per cent; the final showing will probably be somewhat better, with a drop of perhaps 3 per cent.

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El Paso Utility Stages Successful Campaign

IN A RECENT STOCK-SELLING DRIVE, staged to secure local customer-partners, employees of the El Paso Electric Company, El Paso, Tex., placed 3,180 shares of $6 dividend preferred stock. The bogey set for this sale was 2,000 shares, and results achieved exceed this mark by approximately 59 per cent. Approximately 375 employees took an active part in the selling campaign. They were formed into teams, in charge of a team captain, the various department heads acting as team supervisors. A cash bonus of 50 cents a share was paid employees, and in addition suitable prizes were offered for the high team in each department and the high man or woman on each of the teams.

NEW CAPITAL ISSUES

Continental Gas & Electric Corporation made an offering of gold debentures, 5 per cent series A, during the week ended September 25, a piece of financing involving a total of $16,000,000. These securities were offered at 92½ and accrued interest, to yield about 5.53 per cent.

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Chicago District Electric Generating Corporation, formerly the State Line Generating Company, entered the market to the amount of $23,000,000. One offering was in the form of first mortgage 4½ per cent bonds, series A, totaling $15,000,000, priced at 95, to yield more than 4.78 per cent. The second issue of 5½ per cent debentures, priced at par, totaled $8,000,000.

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First and refunding mortgage 4½ per cent gold bonds of the Public Service Company of New Hampshire were offered to the amount of $5,279,000, the price being 99 to yield over 4.56 per cent.

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Insull Interests Follow Aggressive Financing Policy

THE recent offering of a forty-million-dollar note issue by the Corporation Securities Company calls attention to the aggressive financing policy followed this year by the Insull group of utilities. This issue brings the total of Insull securities publicly sold this year to date to $300,000,000. Total financing of the power and light industry has been approximately $1,000,000,000 during the period.

A feature of this year's financing by the Insull group is that more than two-thirds has been in the form of borrowings. This contrasts with the usual Insull policy, especially that followed during 1929.

A large part of this enormous financing program was for the purpose of expansion in some part of the system. The huge amounts spent are a potent factor in the direction of stabilizing business. The two top holding companies, the Middle West Utilities Company and Midland United Company, have continued their aggressive policy of adding subsidiaries and properties while simplifying and strengthening their corporate structures.

A cross-section picture of the Insull system shows five leading companies, four entirely independent of each other. These four own a working control of the fifth, Midland United Company. A sixth is now in process of formation by consolidation of Chicago's local transport facilities. Two investment trusts have been superimposed within the last two years, Insull Utility Investments, Inc., and Corporation Securities Company of Chicago. While their holdings are largely in the "big four," the former has substantial holdings in Midland United as well as owning Insull Son & Company, Ltd., outright. The latter unit is engaged principally in the distribution of securities abroad.

With regard to the banking tie-up between the Insull interests and Halsey, Stuart & Company, *Business Week* makes the following comment:

"Insull Utility Investments was organized by pooling certain stock-holdings of the Insull family. Samuel

Insull, Jr., is president. Corporation Securities was built on certain holdings of Halsey, Stuart & Company in Insull companies, which were combined with other stock owned by the Insull family. H. L. Stuart is president, with Samuel Insull chairman and Samuel Insull, Jr., vice-chairman.

"Halsey, Stuart & Company, which Mr. Stuart heads, is the outlet of Insull bond issues and notes. This concern is consolidation manager of the Chicago transportation merger now under way. Utility Securities Company, owned by other Insull companies, is the selling agency for preferred and common stocks."

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Municipals Have 5 per Cent of Ohio Business

ELECTRIC SERVICE BROUGHT IN a total revenue of $7,134,079 to municipal plants in Ohio during 1928, according to a recently published pamphlet by the Auditor of the state, entitled "Comparative Statistics, Cities of Ohio." Corresponding operating expenditures amounted to $3,817,011. The report covers only communities of 5,000 population or larger, but the inclusion of plants in smaller places would probably not greatly affect the totals. Since expenditures are omitted for some cities and revenue for others, the totals are only roughly comparable.

Of the 24 cities for which statistics are given, several are no longer being served by municipal plants, according to more recent information. Ashtabula and Barberton are the largest of these.

On the basis of earnings municipal establishments constitute about 5 per cent of the electric power industry in Ohio. For comparison, revenue figures for the more important privately owned companies are available in the Bonbright Survey of Electric Power and Light Companies. For the year ended September 30, 1929, the total of these comes to $149,600,000. The omission of small establishments should about balance the inclusion of revenue for other than electric service.

Moderate Gain in Revenue Continues

JULY returns received from electric light and power companies show that revenue continues moderately larger than last year. The advance for the industry as a whole was 2.5 per cent, making the total revenue $166,400,000, compared with $162,300,000 last year and $169,200,000 in June. The decrease from June is no more than seasonal. In both June and July the average daily earnings were 1.9 per cent below the estimated normal based on operations during the past five years.

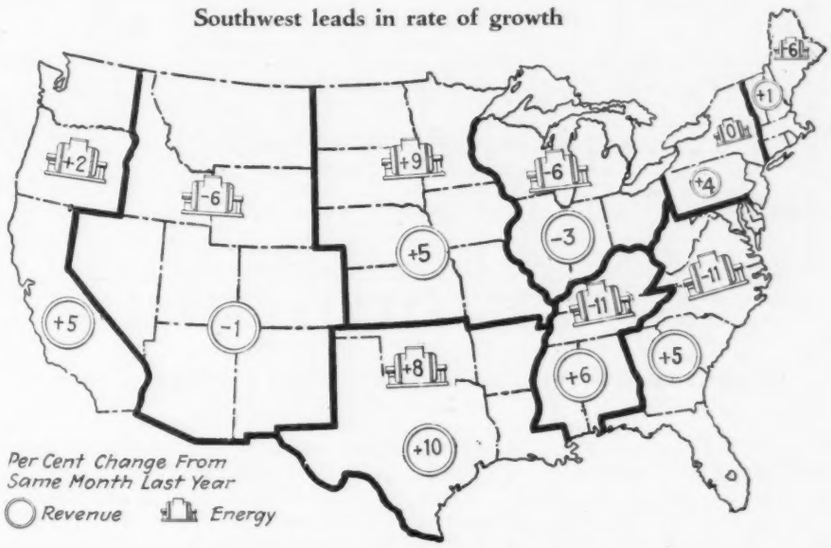
The small deficiency of present operations when set against the industry's development during a series of years, rather than a single year, is worth noting. It brings out the fact that, while the summer's gain over the preceding year is much smaller than usual, the abnormality consisted in the high earnings of 1929, much more than in low earnings of 1930. This is evident from the chart. By the same yardstick, 1928 was virtually a normal year.

Meanwhile operating expenses have increased at a rather smaller rate than revenue; the showing as to net earnings therefore continues favorable.

Individual companies show wide variations from the national rate of gain, which are in part reflected in regional averages. The latter range from a gain of fully 10 per cent in the Southwest to a decrease of 2.6 per cent in the industrial area of the Central States.

Statistics on energy production reflect the unusually low industrial activity. For the third consecutive month the output is smaller than last year, the July figure, 7,329,000,000 kw.-hr., being 2.5 per cent less than in 1929. The only regions gaining were the West North Central, 9.4 per cent; West South Central, 7.5 per cent, and the Pacific, 1.6 per cent. The decrease in the East South Central States as given in Table IV, though correct as to light

Southwest leads in rate of growth



NOTE—Including Muscle Shoals energy the East South Central region increased 6 per cent

Table I—Central-Station Financial Operations in the United States[1]

Compared with Corresponding Month of Previous Year

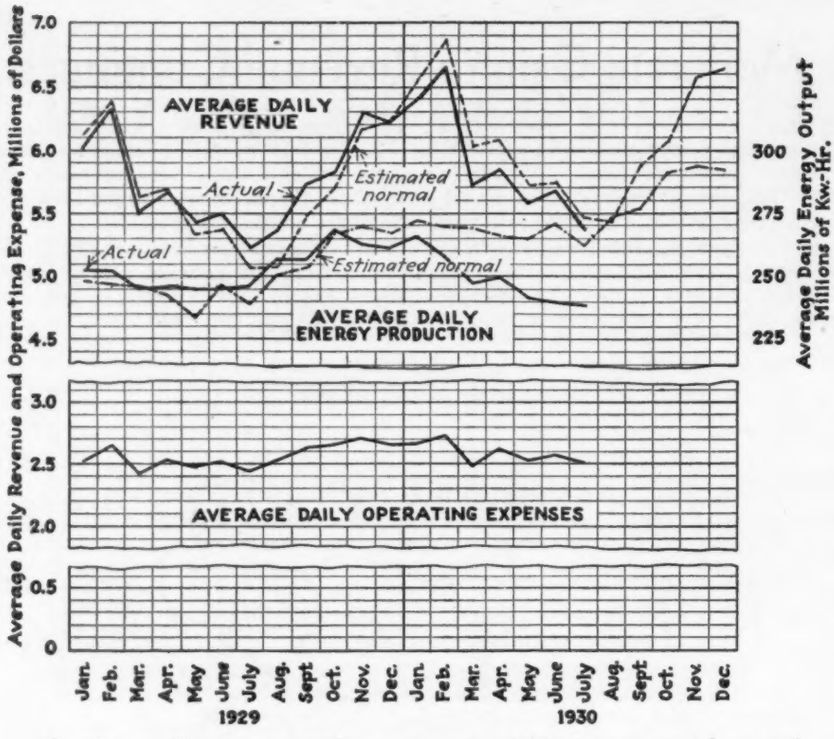
Month	Total Gross Revenue from Sale of Energy*			Total Operating and Maintenance Expense†		
	1930 Thousands	1929 Thousands	Per Cent Inc.	1930 Thousands	1929 Thousands	Per Cent Inc.
April	$176,300	$170,900	+3.2	$78,300	$76,150	+2.9
May	172,900	168,400	+2.7	78,200	76,200	+2.6
June	169,200	165,300	+2.4	76,600	75,650	+1.3
July	166,400	162,300	+2.5	77,400	76,200	+1.6

Table II—Central-Station Fuel Consumption in the United States‡

Compared with Corresponding Month of Previous Year

Month 1930	Coal		Oil		Gas	
	Short Tons	Per Cent Increase	Barrels	Per Cent Increase	Thousands Cubic Feet	Per Cent Increase
April	2,993,321	—4.5	560,274	—8.6	9,525,553	+22.3
May	3,040,644	—1.8	578,532	+2.0	9,595,645	+13.1
June	2,953,289	—5.8	591,505	+1.0	9,859,543	+19.5
July	3,192,597	—3.4	687,172	+2.5	10,361,459	+17.2

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.
†Do not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions. ‡As collected by U. S. Geological Survey.
(1) The financial statistics for 1929 have been revised as explained on page 665 of the issue of March 29, 1930.



Despite small gain over 1929, revenue is within 2 per cent of normal

and power company output, understates the energy consumption of that area. Adding the output of Muscle Shoals changes the decrease to an increase of 6 per cent, part of it used to make up the deficiency of water power in the adjacent South Atlantic States.

The decrease in water power caused by the prolonged drought reduced the hydro output 8.9 per cent below that of July, 1929, making it only 35 per cent of the total, and required an increase of 1.4 per cent in output from fuel, but fuel consumption decreased somewhat, the additional 1,518,858,000 cu.ft. of natural gas and 16,592 bbl. of oil being less than equivalent to the reduction of 111,221 tons of coal.

Table III—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1930	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
April	7,510,801	+1.6	3,082,049	—0.3	4,428,752	+3.0	1,805,000	+16.3
May	7,496,622	—0.3	2,595,645	—9.7	4,541,472	+5.3	1,755,000	+11.7
June	7,211,869	—1.0	2,765,741	—3.4	4,446,128	+0.5	1,828,000	+16.8
July	7,329,027	—2.5	2,592,797	—8.9	4,736,230	+1.4	1,820,000	+13.0

Table IV—Regional Operations, Revenue and Energy Output in July, 1930

Compared with Corresponding Month of Previous Year

Region	Revenue[1]		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	166,400	+ 2.5	7,329,027	— 2.5	2,592,797	— 8.9	4,736,230	+ 1.4
New England	15,920	+ 0.7	446,761	— 6.1	158,688	+12.9	288,073	—14.2
Middle Atlantic	41,270	+ 4.3	1,748,255	— 0.2	419,580	— 2.8	1,328,675	+ 0.6
East North Central	40,180	— 2.6	1,695,432	— 5.5	142,702	—27.7	1,552,730	— 2.8
West North Central	14,100	+ 5.0	496,031	+ 9.4	126,669	— 8.8	369,362	+17.5
South Atlantic	17,840	+ 4.7	802,851	—10.9	342,117	—28.0	460,734	+ 8.2
East South Central	5,780	+ 6.3	257,316	—10.7	182,392	—21.4	74,924	+33.6
West South Central	10,420	+10.2	457,155	+ 7.5	2,771	—37.8	454,384	+ 8.0
Mountain	4,110	— 0.8	319,078	— 5.9	272,945	— 4.6	46,133	—12.9
Pacific	16,780	+ 5.3	1,106,148	+ 1.6	944,933	+ 0.4	161,215	+ 8.8

*As collected by U. S. Geological Survey.
(1) The revision of the statistics on revenue is discussed in the issue of March 29, 1930, on page 665.

Recent Listings

NEW YORK STOCK EXCHANGE has authorized the listing of first mortgage gold bonds of the Kansas Gas & Electric Company to the amount of $16,000,000. These bonds bear interest at the rate of 4½ per cent and mature July 1, 1980.

New York Stock Exchange has also authorized the listing on or after October 1 of not exceeding 4,750 additional shares of common stock of the Federal Light & Traction Company.

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NEWS BRIEFS

Milwaukee Electric Railway & Light Company has called for payment on December 1, 1930, its general and refunding mortgage 5 per cent gold bonds, series A. The holders of these securities are offered the privilege of receiving in exchange either a like principal amount of refunding and first mortgage gold bonds, 5 per cent series B, due June 1, 1961, with all unmatured coupons, and $30 in cash for each $1,000 principal amount of the series A bonds so surrendered, or 105 per cent of the principal amount of the series A bonds with accrued interest to the date of surrender.

•

Central Illinois Securities Corporation has purchased a substantial block of common stock of the North Continent Utilities Corporation. North Continent furnishes public utility service in seven states in the United States and two provinces in Canada.

•

Public Service Corporation of New Jersey will offer its $5 cumulative no-par preferred stock under the popular ownership plan in a campaign which will start October 1. Stock will be priced at $97.50 a share and accrued dividends for cash, or on terms of $10 a share down and $10 monthly thereafter until the final payment of $7.50. Purchasers will receive interest on installments as paid at the rate of 5 per cent per year.

•

Philadelphia Electric Company has called for redemption October 1 $206,000 of first mortgage sinking fund 5 per cent gold bonds, due 1966, at 105 and interest.

•

Philadelphia Company has declared an extra dividend of 15 cents a share on the common stock, payable October 31 to holders of record October 1, in addition to the regular quarterly dividend of 20 cents. At the same time a dividend of $1.50 a share semi-annually was declared on the 6 per cent cumulative preferred stock (par $50) payable November 1 to holders of record October 1.

Business News and Markets

Electrical Manufacturing Fairly Active—Above General Level

ELECTRICAL manufacturing establishments continued operations during August at a rate that compares most favorably with other industries. Data on energy consumption received by the ELECTRICAL WORLD from plants accounting for two-thirds of the total indicate this year's August operations to be only 2 per cent below last year's; similar returns for other industries show the general industrial level to be down 17.6 per cent. (See ELECTRICAL WORLD, September 20, 1930, page 543.)

For the first eight months the 1930 average exceeds that of 1929 by 1.3 per cent; the average for all industries, on the contrary, is down 13.2 per cent.

Compared with July, and taking account of the number of working days, electrical manufacturing activity rose 2.5 per cent, stood at nearly the same level as in March and continued somewhat lower than during the intervening months. Normally operations in August are 3 per cent slower than in July. For a time the large establishments were apparently a good deal more active than the smaller ones, each group being considered as a whole. Recently this disparity has been lessening, the two groups drawing toward each other.

Indexes of Electrical Manufacturing

August, 1930	152.2
July, 1930	148.5
June, 1930	160.2
May, 1930	158.0
August, 1929	155.4
First eight months 1930	157.3
First eight months 1929	155.2

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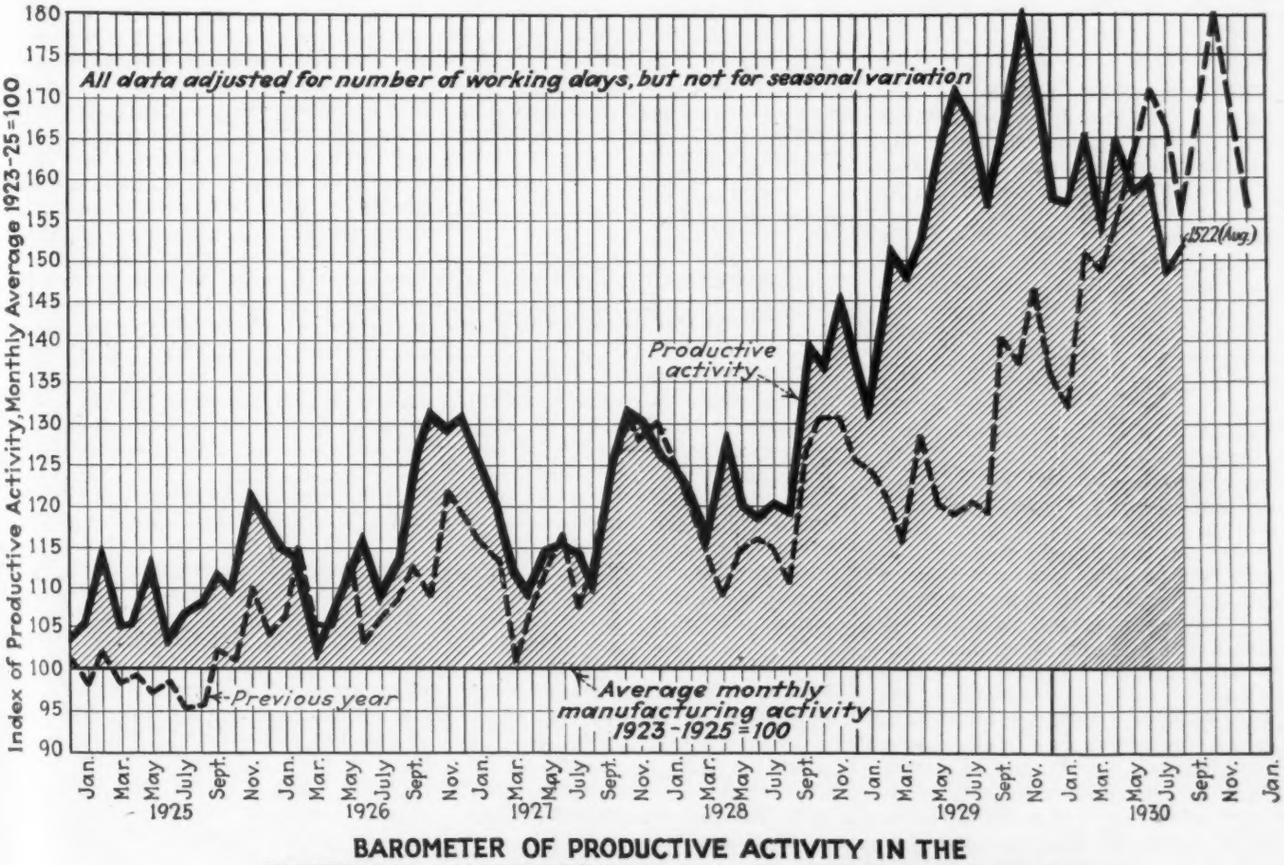
New Canadian Tariff Rates

SOME OF THE ITEMS included in the new Canadian tariff which are of interest to the electrical manufacturing industry follow; the United States is included in the general list:

	British Preferential, Per Cent	Favored Nations, Per Cent	General, Per Cent
Refrigerators	20	27½	30
Washing machines	15	25	35
Electric light fixtures	20	30	30
Arc and incandescent lamps	20	30	30
Motors and parts	25	33⅓	37½
Dynamos, generators and transformers	25	33⅓	37½



BAROMETER OF PRODUCTIVE ACTIVITY IN THE ELECTRICAL MANUFACTURING PLANTS OF THE UNITED STATES

Market Conditions

ROUTINE business is improving definitely and September reports are better on the Pacific Coast. Crop money is expected to increase volume sharply. Substantial contracts for industrial account are recorded in the East, but utility business is still very low. Middle West business continues quiet with some signs of improvement.

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EASTERN

—SEVERAL IMPORTANT CONTRACTS *for electrical equipment have gone to inspire interest in an otherwise rather listless market in the Eastern district. Central station commitments continue to show an appreciable decline as compared with a few weeks ago, and while inquiries show upward tendencies, current requirements are restricted.*

—INDUSTRIAL ACCOUNT SHOWS *better prospects in some of the major lines of trade, particularly iron and steel mills, and some sizable orders are anticipated. Wire and cable is securing an improved demand and the outlook is more favorable than for some time past. Electrical supplies show little change and business is quiet.*

Following recent activity of the American Telephone & Telegraph Company in the copper market, purchasing a sizable tonnage of raw material for use over a four-month period at the wire and cable manufacturing plants of its subsidiary, the Western Electric Company, other leading interests show advancing proportions. The General Cable Company is increasing production at its Buffalo, N. Y., plant, and sales are registering a 10 per cent gain over a few weeks ago. The Anaconda Wire & Cable Company, a subsidiary of the Anaconda Copper Company, has closed an important contract with the Pacific Gas & Electric Company for 4,250,000 lb. of 500,000-circ.mil hollow cable for a new transmission line, a record commitment for some months past.

A Pennsylvania producer has a contract for outdoor transformer equipment, tension coils and auxiliary apparatus from a Pacific Coast municipality, approximating $80,000. Pending business is centered in substation and line equipment, including indoor and outdoor transformers, high-tension buses, switching and kindred apparatus. Motor account is turning upward in the industrial field and business for the next 30 to 60 days shows up better than for several weeks past. Trade is about 75 per cent of normal, according to a leading maker. A New Jersey manufacturer has secured several commitments for heavy duty units for steel mill service.

CONSTRUCTION PROJECTS

Purchasing and Contracting Officer, Medical Section, Army Base, Brooklyn, N. Y., will receive bids until September 30 for two automatic air compressors (Circular 28). Niagara Hudson Power Corporation, Buffalo, N. Y., plans hydro-electric power plant on Hudson River near Hadley, N. Y., reported to cost over $1,000,000. Sinclair Refining Company, New York, plans expansion program at oil-refining plant at Houston, Tex., to cost about $2,000,000. Buffalo General Electric Company, Buffalo, N. Y., has plans for three power substations to cost over $85,000. Commissioner of Institutions and Agencies, Trenton, N. J., will receive bids until September 30 for a power plant at the local state prison; also, until October 3 for coal-handling equipment. Gulf Pipe Line Company, Pittsburgh, Pa., plans power plant at Greenwood, Ind., to cost $250,000. United State Engineer Office, Pittsburgh, Pa., will receive bids until September 30 for two hydraulic turbines (Circular 173). Pennsylvania Railroad Company, Pittsburgh, Pa., plans freight terminal at Youngstown, Ohio, to cost $1,000,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until September 30 for motor-generator sets (Schedule 4062), and until October 7 for quantity of lighting and power cable (Schedule 4155.)

Zimmermann Advises Buying Materials Now

BELIEVING that business conditions and prices have reached the turning point, John E. Zimmermann, president of United Gas Improvement Company, advises all large purchasers to buy materials and supplies for future needs at once. Mr. Zimmermann sent a letter to this effect to local managements of United Gas subsidiaries. Part of the letter follows:

"It is felt that the purchase of materials can be made advantageously at this time and that improvement in business conditions may make later purchases less favorable. Business conditions in this country are essentially sound, and I look for a steady and gradual improvement."

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PACIFIC COAST

—SEPTEMBER REPORTS ARE SWINGING UPWARD *and despite another market sag prosperity seems to be returning. Manufacturers report no big machinery jobs in sight for the coming months, but there is a definite improvement in what they term bread and butter lines.*

—CONTRACTORS REPORT THAT SOME *big jobs are breaking at last and country dealers expect that crop money will soon improve their districts. Considerable overproduction will, however, cut this volume.*

Orders include $30,000 worth of Westinghouse oil circuit breakers for Woodland, Wash., elevator motors and motor-generator sets valued at $35,000 for Los Angeles, $15,000 worth of General Electric trunk units and switching gears for San Francisco, a carload of Westinghouse ranges for Portland, $35,000 worth of General Electric distributing transformers for the Pacific Gas & Electric system, General Electric car equipment valued at $15,000 for the city and county of San Francisco, and $20,000 worth of industrial heating equipment for the Shell chemical plant near Martinez. Government buying includes two small power lines for the Delta reclamation district, turbo-generator sets and portable electric drills and lathes for Mare Island navy yard, $2,000,000 worth of work for the Letterman Hospital in San Francisco, air base buildings valued at $3,000,000 for Alameda, and building construction of more than $800,000 for the new army bombing base near San Rafael. This base will also include a $25,000 radio station. Power purchasing was limited to repair and maintenance material, besides the machinery noted above.

Motor and apparatus sales in Seattle and Puget Sound district continue light, although there are several large orders in immediate prospect from pulp, paper and lumber mills. The wiring device volume is reported from fair to good, but industrial business is slack. Domestic appliances, radio and range sales are good and increasing in volume. The movement last week included eighteen machines from 30 hp. down to dealers, 40 synchronous motors from 125 hp. down to a mining company, $3,500 worth of motors to the White River Lumber Company, near Seattle; one 300-hp. machine to a Grays Harbor mill and twenty motors from 50 hp.

down to scattered industrials. Another Seattle jobber reported the sale of a considerable number of high-tension connectors, two plating motor-generator sets and a number of exhaust and furnace fans. Salem, Ore., in November will vote on a $5,000,000 issue for a projected municipal power and light plant; Washougal, Wash., is taking bids until October 8 for a lighting system involving 34 lights on iron standards for underground connections, and Hood River, Ore., will open bids on October 6 for a lighting system in connection with a $53,000 hydro-electrical power plant and distribution system under construction.

CONSTRUCTION PROJECTS

Fresno Irrigation District, Fresno, Calif., plans hydro-electric power project on San Joaquin River for capacity of 76,000 hp., to cost over $1,000,000. American Rubber Producers, Inc., Salinas, Calif., has plans for plant to cost $135,000. South San Francisco, San Clemente, Woodland and Fortuna, Calif., plan ornamental lighting systems. Puget Sound Power & Light Company, Seattle, Wash., plans extensions in power substation and transmission lines at Arlington, Wash., to cost $115,000, and addition to power substation at Snohomish, Wash., to cost $40,000. Public Service Company of Colorado, Denver, plans power substation on Irving Street to cost about $40,000. General Electric Broadcasting Company, Denver, Colo. (Station KOA) plans 50,000-watt transmitting station to cost $250,000.

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SOUTHEAST

—ACTIVITIES IN THE SOUTHEAST *continue quiet, with purchases principally for current requirements; however, there seems to be more of a feeling of optimism regarding business prospects for the remainder of the year.*

A Georgia power company ordered oil circuit breaker equipment amounting to $13,000, while a North Carolina company ordered similar equipment totaling $10,000. A Tennessee company purchased switchboard equipment amounting to $7,000. Some other central station orders in the week for $5,000 of voltage regulators, $4,765 of disconnect switches, $5,250 of transformers, $4,000 in house type meters and creosoted pine poles amounting to $3,720. The coal and iron interests in the Birmingham territory were responsible last week for an order for switchboard equipment costing $60,000. A cotton mill in Georgia ordered $8,000 in motors and switchboard equipment for an addition to plant, while a textile mill in Tennessee purchased motors to the extent of $6,000. Additional motor orders are to be placed shortly by this latter mill. Wiring contract is to be let this week on an office building addition in Atlanta which will involve $30,000 in wiring supplies. Two municipalities in Georgia placed orders for distribution construction materials, one for $1,500 and the other $4,000. The latter covers a new system project.

CONSTRUCTION PROJECTS

Lane Company, Altavista, Va., has plans for an addition to cedar chest plant to cost $140,000. McKenzie, Tenn., plans extensions and improvements in municipal electric light and power plant, including installation of additional equipment. Fiske University, Nashville, Tenn., plans chemistry building to cost $125,000. Wilson, N. C., has approved plans for addition to municipal power plant, and will install additional equipment. Woodville, Miss., will receive bids until October 7 for a 180-kva. alternator, 15-kw. exciter, voltage regulator and other equipment. Arkansas Power & Light Company, Pine Bluff, Ark., contemplates high-tension transmission line from Carpenter to Woodward, Ark., and vicinity, and will build addition to power substation at Montrose, Ark.

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NEW ENGLAND

—INTEREST IN HEAVY ELECTRICAL *equipment for this district is slackening, as many of the year's construction projects have been completed and plans for future developments as yet have not been formulated. Orders for motors are being received in fair volume.*

During the past week an order for sectional drive equipment consisting of motors and control accessories amounting to more than $85,000 was received by a prominent manufacturer. Single orders of small motors are quite steady, but, as compared with last year, below the level of volume reported at this time of year. The demand for central station supplies has slackened, though wire and cable is moving fairly well and small lots of line hardware were recently placed. Street-lighting units were recently sold for a number of eastern Massachusetts municipalities and a number of spotlights were recently ordered. A quieter trend is noted in the movement of scheduled materials. Merchandising is spotty. Electric clock sales and refrigerators continue to meet with favor. Recently the New England Bell Telephone system announced that plans had been completed for the expenditure of more than $200,000,000 during the next five years.

CONSTRUCTION PROJECTS

Bureau of Supplies and Accounts, Navy Department, Washington, D. C., is asking bids until October 7 for motors and ventilating sets for the Portsmouth, N. H., navy yard (Schedule 4005). Malden Electric Company, Malden, Mass., plans equipment storage, service and distributing plant to cost close to $60,000. Condit Electrical Manufacturing Corporation, Boston, Mass., plans addition to cost about $65,000.

MIDDLE WEST

—VERY LITTLE CHANGE *in general business is noticeable this week in the Middle West section. While indications point to a recovery of business to some extent, general business is still quite spotty. The business attitude appears more optimistic and the tendency seems to be to accept hopefully any indication of a return of business. However, considerable-cross currents are in evidence and the necessary stimulus to start business definitely on the up grade seems lacking.*

Major activities appear to be marking time. Retail trade is improving and a general improvement is looked for from now on. The various transportation companies are getting started with some of their construction plans, while the utility companies are proceeding conservatively with their investment programs. Some of the interesting orders placed this week include one for fabricated steel to cost $55,000, one for "Mazda" lamps valued at $150,000 and several construction orders.

A slight acceleration in jobbers' sales is noticeable this week. More inquiries are being received and business is a trifle more steady. There has been a fair demand for most appliances, with an increasing demand for "cool morning" appliances. Code wire prices were reduced about 5 per cent this week.

CONSTRUCTION PROJECTS

Wauwatosa, Wis., contemplates an ornamental lighting system. A. O. Smith Corporation, Milwaukee, Wis., will proceed with addition to machinery plant to cost $200,000. Squire-Dingee Company, Chicago, Ill., will build an addition to food products plant to cost $100,000. Rock Island, Ill., plans installation of electric power equipment in connection with river terminal to cost $300,000. Waukegan, Ill., is planning an ornamental lighting system. Vortex Manufacturing Company, Chicago, Ill., has filed plans for an addition to paper cup factory to cost $300,000. Saginaw Steering Gear Division of General Motors Corporation, Saginaw, Mich., plans extensions to cost over $400,000. Roach-Appleton Manufacturing Company, Chicago, Ill., will proceed with electric equipment manufacturing plant at South Bend, Ind., to cost $150,000. Wells, Minn., will make extensions and improvements in municipal electric power plant. Independence, Iowa, contemplates purchase of Diesel engines and accessories. Cedar Rapids, Iowa, plans ornamental lighting system.

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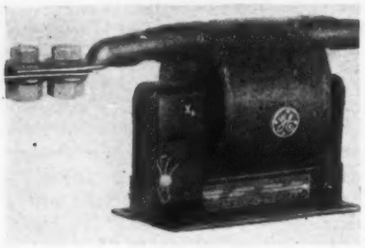
New York Metal Prices

	Sept. 17, 1930 Cents per Pound	Sept. 24, 1930 Cents per Pound
Copper, electrolytic	10⅛	10⅛–10⅛
Lead, Am. S. & R. price	5⅛	5⅛
Antimony	7½	7.70
Nickel, ingot	35	35
Zinc, spots	4.60	4.60
Tin, straits	29.85	29¾
Aluminum, 99 per cent.	23.30	23.30

New Equipment Available

Current Transformer Eliminates Errors

CURRENT TRANSFORMERS embodying compensating features which practically eliminate ratio and phase-angle errors have recently been placed on the market by the General Electric Company, Schenectady. The new transformers, built in ratings from 5 to 800 amp. and designed for 5,000-volt operation, are



for use in connecting watt-hour meters, instruments and relays the combined burden of which does not exceed 50 volt-amp. They have practically straight line accuracy down to 5 per cent load and are arranged for either flat-surface or pipe mounting, with a base which affords great accessibility. Two bolt-hole terminals are employed on this instrument, which is designated type WF-1.

▼

CONNECTORS FOR WIRES, CABLES AND RODS, that can be locked when installed, are announced by the Burndy Engineering Company, Inc., New York City. There are only two parts to this device. It consists of a U-bolt in one piece and a nut, U-clamp and locking device in another piece. The parts are constructed of forged copper, so that they will not corrode or season-crack when exposed outdoors, as sometimes happens to ordinary brasses. All parts that grip the wires or cables are rounded at the edges so as not to nick the cable and thereby accelerate breakage.

▼

Switch Combined With Outlet Cover

FOR PIPE JOBS IN modern industrial buildings combination ceiling pull switches and outlet box covers are announced by the Arrow Electric Division of the Arrow-Hart & Hegeman Electric Company, Hartford, Conn.

The device combines the switch mechanism and a decorative outlet box cover into a single unit, an arrangement which makes it possible to install it more quickly and reduces two stock items to one, as against separate switches and outlet box covers. This combination comes made up with 3¼ or 4-in. covers, which are held in place by one screw in the center, making for easy assembly.

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Portable Machine for Field Welding

A NEW PORTABLE GAS-ENGINE-DRIVEN WELDER with a rating of 400 amp. has recently been placed on the market by the Lincoln Electric Company, Cleveland, Ohio. The growing use of larger sized electrodes led to the development of this larger machine, which is designed for field work in all kinds of construction work, such as structural, oil and gas lines, field repairs, ship repairs, shipbuilding, etc.

It is rated at 400 amp., with a current range up to 500 amp., and it is of the variable-voltage single-operator type, operating at 1,500 r.p.m. It is driven by a six-cylinder engine with an S.A.E. rating of 33.75 and a brake horsepower at 1,500 r.p.m. of 55. The outfit is equipped with an automatic throttle control which permits the engine to idle at about half speed when the arc is not going.

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Oil Circuit Breakers for 69-kv. to 230-Kv. Service

FLOOR-MOUNTED OIL CIRCUIT BREAKERS for use on transmission systems operating at voltages from 69 kv. to 230 kv., with interrupting capacities up to 2,500,000 kva., are announced by the Pacific Electric Manufacturing Corporation, San Francisco.

These circuit breakers are equipped with roller bearings on the control shaft. The rotating element that carries the horizontal blade is composed of a bakelite tube having a dielectric strength far in excess of the A.I.E.E. test specifications and a mechanical safety factor that precludes any possibility of breakage.

The tanks are made of heavy boiler plate steel reinforced by longitudinal ribs welded to the inside of the top, both top and bottom of the tank being a one-piece bumped sheet.

Thermal Cutouts for Transformers

THERMAL TRANSFORMER CUTOUTS designed to eliminate the burning out of transformers due to overload are announced by the Line Material Company, South Milwaukee, Wis. These cutouts consist primarily of a double-pole switch which ordinarily is held in the closed position by a metal link. This link, in turn, is locked in position in a metal block by means of an alloy that melts at a low temperature.

The metal block is positioned over two resistance or heating elements which form the inside connections or legs of the transformer winding. Instead of joining the inside leads of the transformer winding just as they are brought from the transformer, the leads are joined to two terminals of the cutout and are then tied together at the opposite terminals of the cutout, thereby causing all currents circulating in either or both coils of the transformer to pass through these heating elements.

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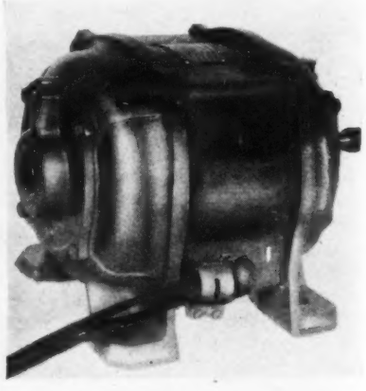
Industrial Motors With Artistic Lines

MOTORS FOR LOOM SERVICE, having high mechanical strength, high electrical efficiency, high power factor and adequate overload capacity, have recently been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh. An artistic and pleasing appearance has been incorporated in the design of these motors, so that they blend in with the outline of the looms which they drive.



This motor will carry sustained overloads for a long period of time without being damaged. The oiling arrangement is convenient and accessible, and an oil overflow is provided to conduct the excess oil outside the motor to a point which makes it instantly apparent that too much oil is being used.

Engineering Library

SEP 29 1930

DESIGN AND CONSTRUCTION NUMBER

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SEPTEMBER 27, 1930

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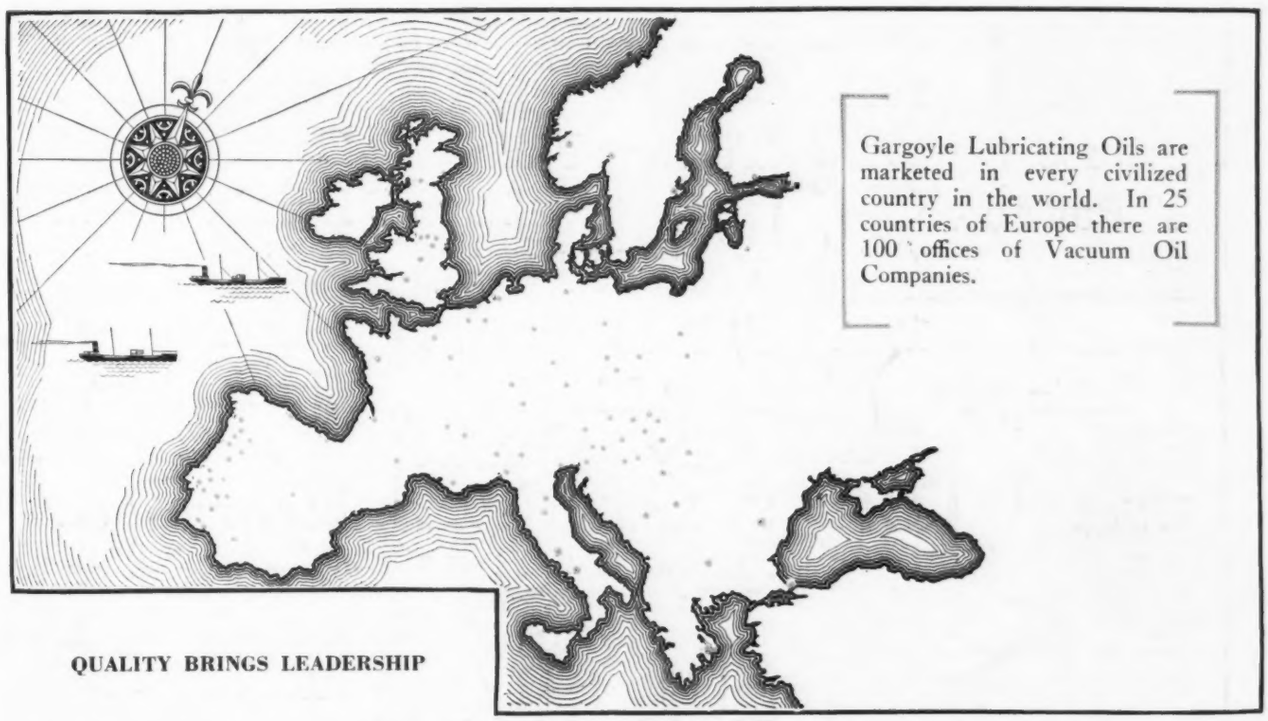

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Toledo	1913	Spain	1917	Norfolk	1925
Chattanooga	1913	Calgary	1917	Lowell	1925
Australia	1913	East Hampton	1918	Waukegan	1926
Africa	1913	Turners Falls	1918	Ossining	1927
France	1913	Yonkers	1920	Lorain	1927
Youngstown	1914	El Paso	1921	Seattle	1927
Cohoes	1914	Long Island City	1922	Akron	1928
Washington	1914	St. Louis	1922	Birmingham	1928
Utica	1914	Gary	1922	Los Angeles	1929
Albany	1915			New Orleans	1930
Baltimore	1915			Portland, Ore.	1930
Niagara Falls, Can.	1915			Tacoma	1930
Dayton	1916			Houston	1930

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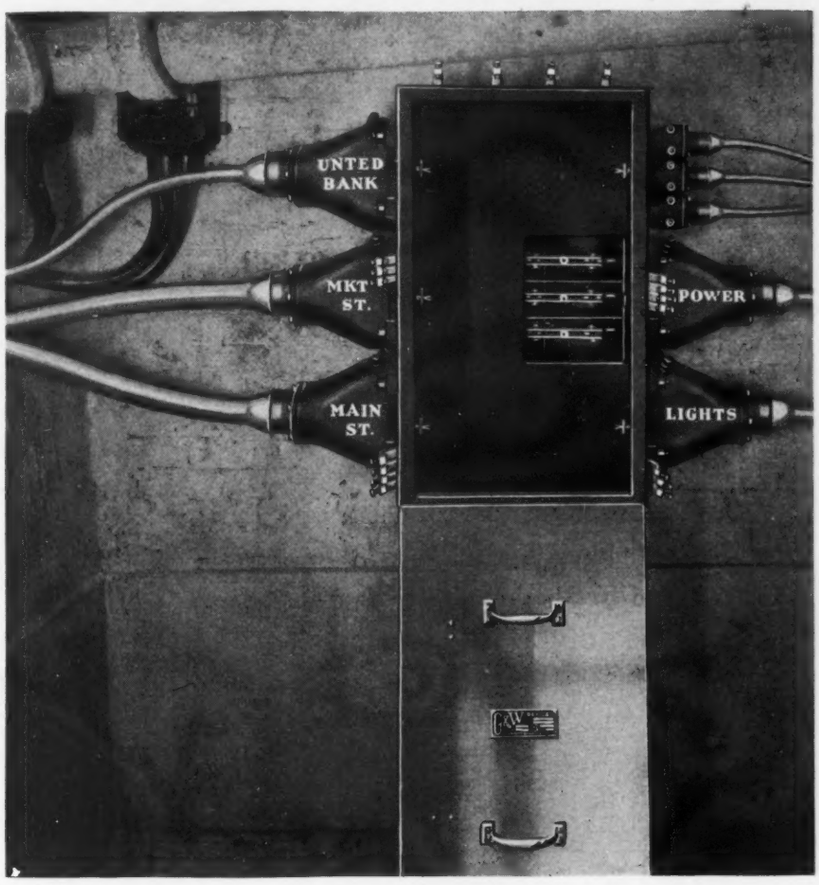

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Novelty Electric Co., Philadelphia, Pa. F. D. Lawrence Electric Co., Cincinnati, O.

Canadian Representatives: Engineering Materials, Limited, Montreal

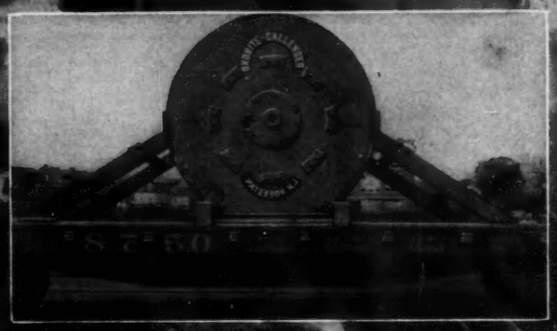
Cuban Representatives: Victor G. Mendoza Co., Havana

OKONITE

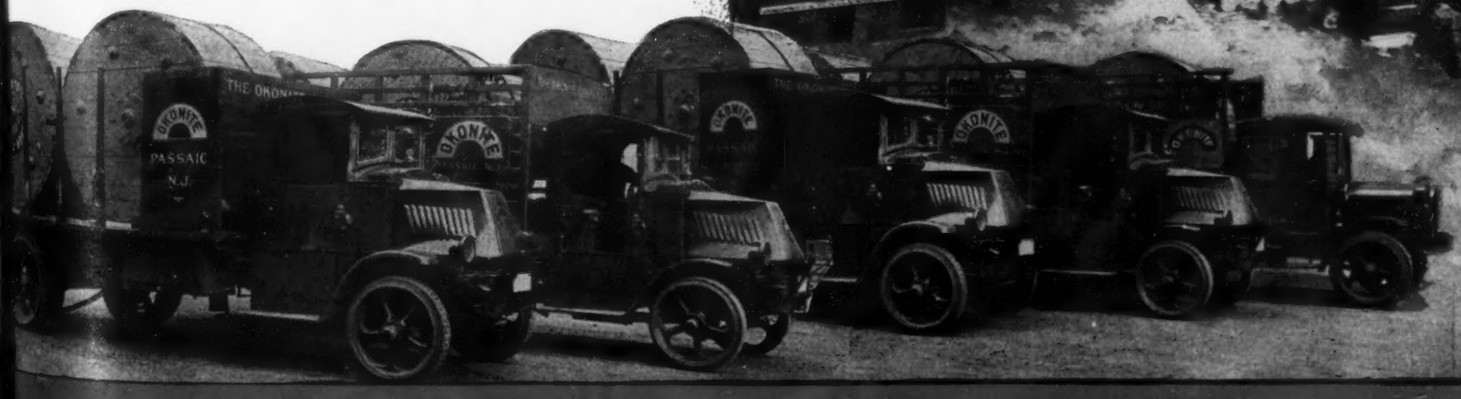
OKONITE-CALLENDER

OKONITE QUALITY CANNOT BE

OKONITE-CALLENDER CABLES
of customer satisfaction

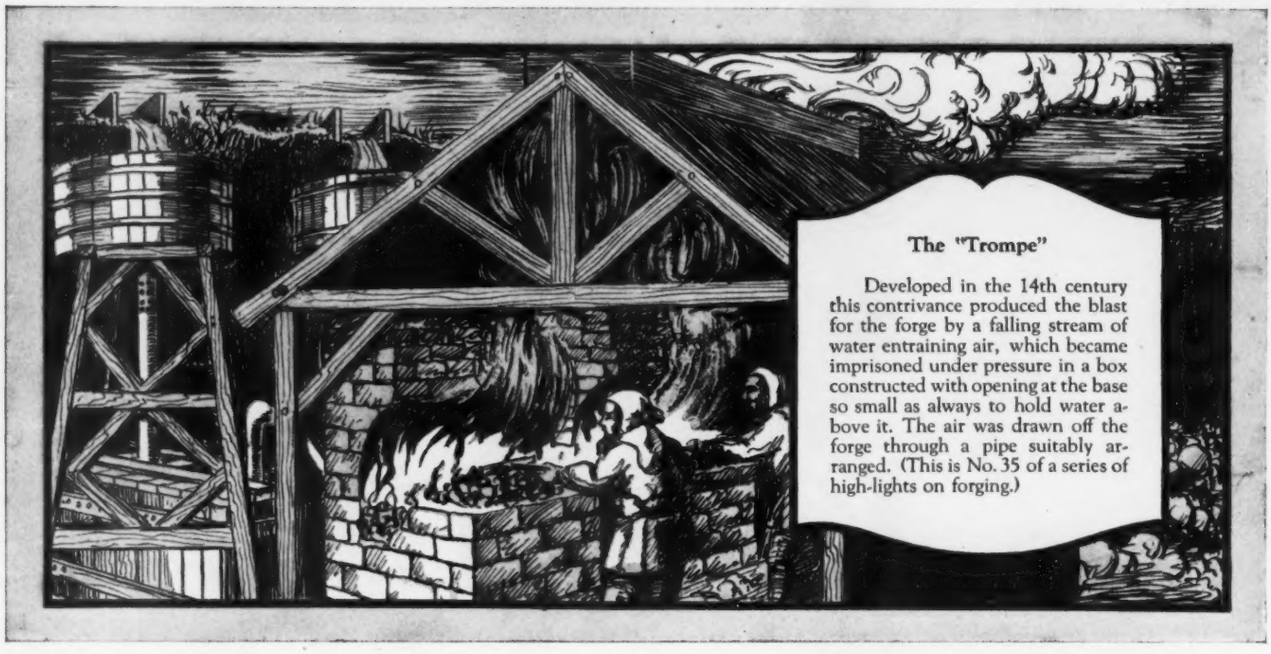


Airplane view of the OKONITE-CALLENDER Cable Co.'s plant at Paterson, New Jersey, where every modern facility is installed for the specialized manufacture of impregnated paper insulated cables of all types.



WRITTEN INTO A SPECIFICATION

Present Day
Standards Demand
Drop Forgings



The "Trompe"

Developed in the 14th century this contrivance produced the blast for the forge by a falling stream of water entraining air, which became imprisoned under pressure in a box constructed with opening at the base so small as always to hold water above it. The air was drawn off the forge through a pipe suitably arranged. (This is No. 35 of a series of high-lights on forging.)

Keeping Pace with Industry

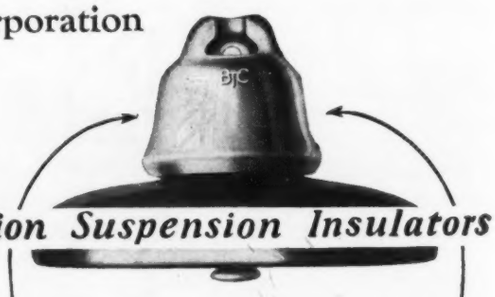
WITH the advancement of civilization has come a demand upon the manufacturer for better products and better service until the pace has become a dazzling fast one. Always playing an important part in this demand is the forger who has kept astride from the start.

For high tension suspension insulators, higher strength, uniformity and corrosion resisting caps were required. The problem was solved by the forger, for in no other metal is the same strength available with such lightness—no other process able to produce with such uniformity and no metal to be had that can surpass Copper-Bearing steel for resisting corrosion in commercial use. All these factors are present in a BTC drop forged cap for high tension suspension insulators. Specify them when ordering.

Why a Drop Forged Cap?

1. They are uniform in quality
2. They are superior in strength
3. They are made of anti-corrosive steel
4. They are uniform in dimensions
5. They can be heat treated to give maximum strength with minimum weight
6. They have precision milled joints and drilled holes
7. They allow a smooth, even porcelain seat
8. They are free from hidden defects and concealed flaws

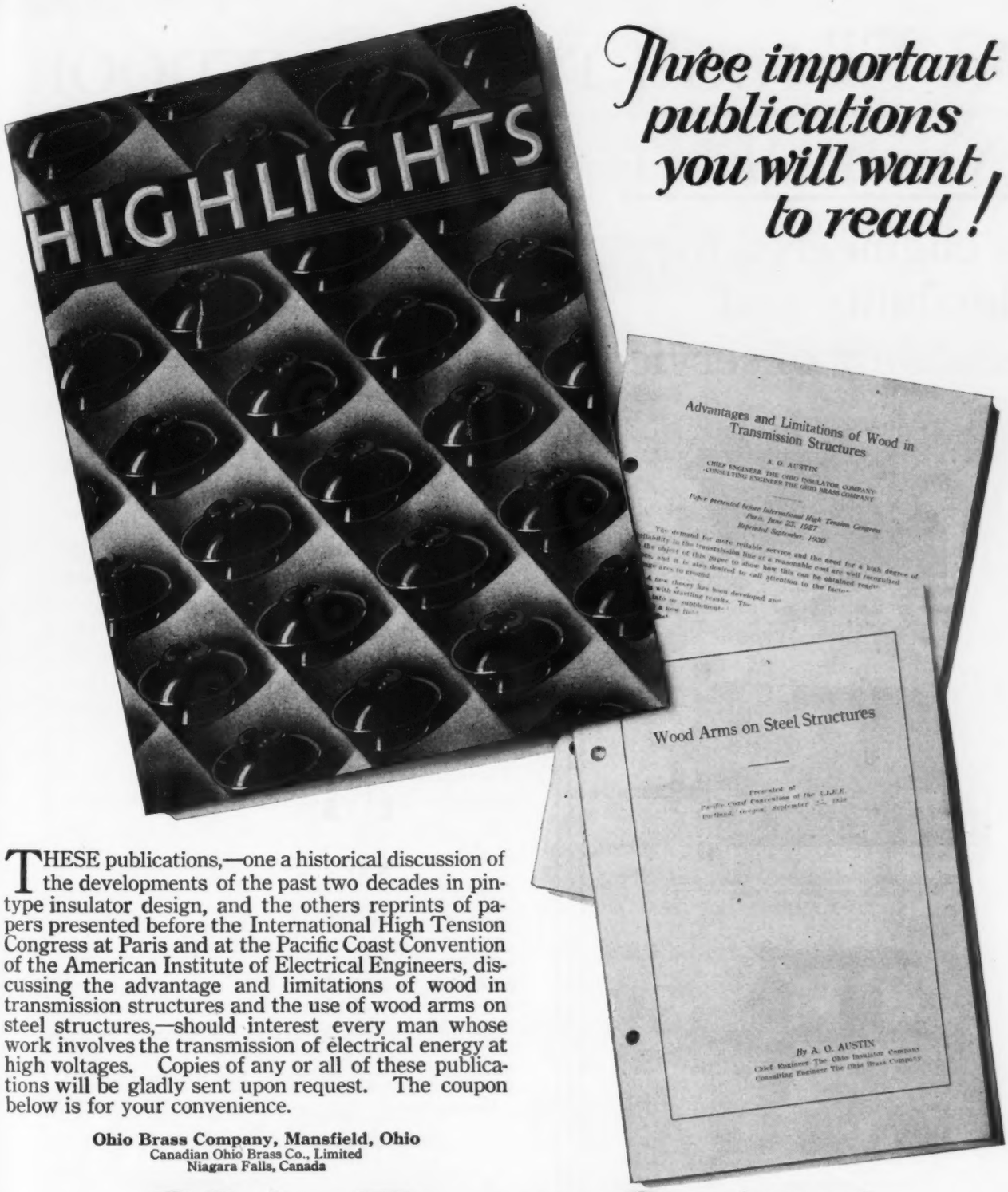
The Brewer-Titchener Corporation
Cortland, New York



For High Tension Suspension Insulators

Specify BTC Drop Forged Caps

Three important publications you will want to read!



THESE publications,—one a historical discussion of the developments of the past two decades in pin-type insulator design, and the others reprints of papers presented before the International High Tension Congress at Paris and at the Pacific Coast Convention of the American Institute of Electrical Engineers, discussing the advantage and limitations of wood in transmission structures and the use of wood arms on steel structures,—should interest every man whose work involves the transmission of electrical energy at high voltages. Copies of any or all of these publications will be gladly sent upon request. The coupon below is for your convenience.

Ohio Brass Company, Mansfield, Ohio
Canadian Ohio Brass Co., Limited
Niagara Falls, Canada

Ohio Brass Co.

NEW YORK PHILADELPHIA PITTSBURGH BOSTON CHICAGO CLEVELAND LOS ANGELES ST. LOUIS ATLANTA DALLAS SAN FRANCISCO SEATTLE

PORCELAIN INSULATORS
LINE MATERIALS
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Ohio Brass Co., Mansfield, Ohio

Please send me the publications checked below.

- ☐ Highlights of Pin Type Insulator Development.
- ☐ The Advantages and Limitations of Wood in Transmission Structures.
- ☐ Wood Arms on Steel Structures.

Company .....

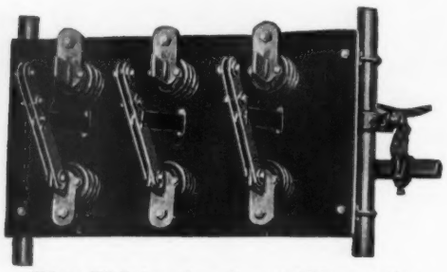
Individual ..... Title .....

Complete Postal Address .....

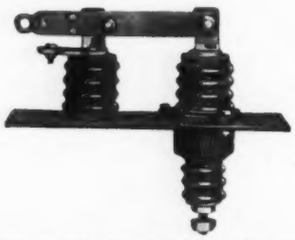
"3-E" HIGH TENSION INDOOR EQUIPMENT

is engineered for flexibility and economy of service

"Three E" Indoor Cable End Bells made in a variety of shapes and sizes for all needs.



"Three E" Indoor Gang Operated Disconnecting Switches, each a complete, self-contained unit, rigidly mounted.



"Three E" Double Blade Indoor Disconnecting Switches offer maximum contact with cool blade operation. Blades won't freeze shut. Adjustment of contacts easily made.

"Three E" U Bolt and Clamp Pipe Fittings. More than 100 types each of numerous sizes.

"Three E" Indoor Insulating Supports for carrying any type of bus in any way.

***SERVICE VALUE**

"Three E" high tension line and station equipment is designed by experienced engineering talent. These men have, in every case, provided for both immediate and future needs. This built-in flexibility proves of real economy during an expansion program. Behind this engineering talent are extensive and modern manufacturing facilities.

To include this equipment when designing a substation is to get the maximum of economy and greatest efficiency over longest periods of time.

Ease of operation and safety characterize all "Three E" equipment.

Consult with our engineers regarding your problems.

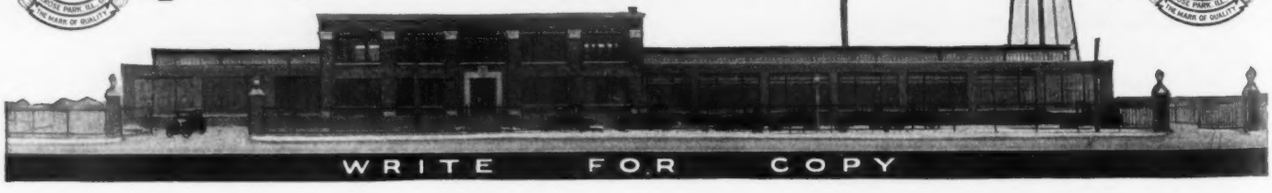
***"Service Value" = Low cost per year of service**

ELECTRICAL ENGINEERS EQUIPMENT CO.
General Offices and Factory: MELROSE PARK, ILL.

Chicago Office: 205 W. Wacker Drive
Eastern Office: 21 Park Row, New York
Sales Offices in all principal cities

Canadian Representative Northern Electric Company LIMITED

It Pays to use the "Three E" catalog



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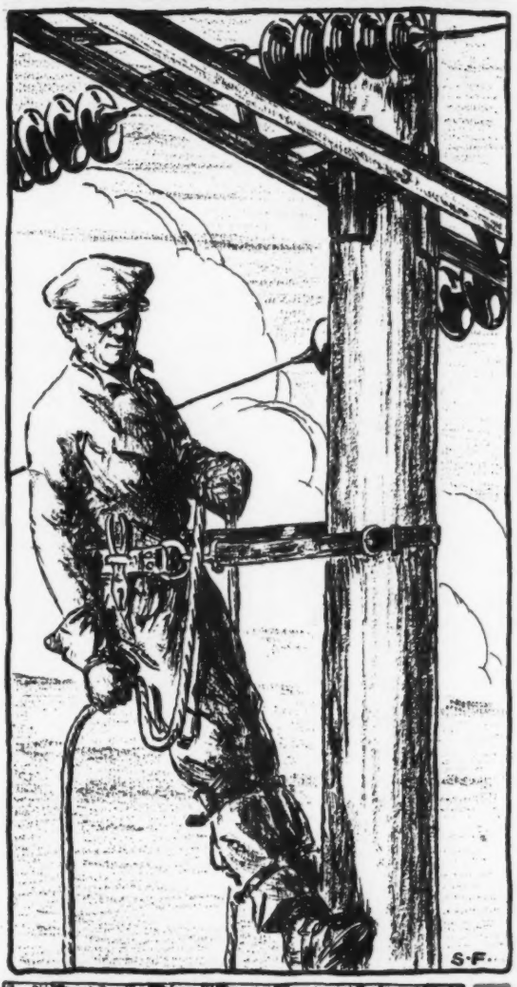
safety first

BUILT BY NATURE

In their campaigns to reduce accident hazards for their employees, the utilities have been quick to recognize the outstanding qualities of Western Red Cedar poles.

Linemen work on these poles with a feeling of security and safety, for the danger incident to working on "hot" circuits is greatly reduced.

Aside from this important feature, the smooth, clean surface of cedar and its firm wood structure are ideal for climbing. They have contributed to the lineman's unmistakable partiality to Western Red Cedar poles—a preference that is shared by employees and utilities.



WESTERN RED CEDAR ASSOCIATION
Executive Offices—Spokane, Wash.
Research Division—Minneapolis, Minn.

western red cedar poles

the choice of the utilities

Our one aim

LINE MATERIAL equipment is practical and of proven value in service. Material is chosen for quality. Mass production keeps your cost down. « « « « Besides lower installation cost, and long life of L-M equipment—there is the advantage of experienced engineering service and facilities for producing distribution equipment to suit your particular needs.

Do you get "THE LINE" » our own monthly publication on new equipment and developments in the field. If not, write us and we will place your name on our mailing list.

LINE MATERIAL CO.

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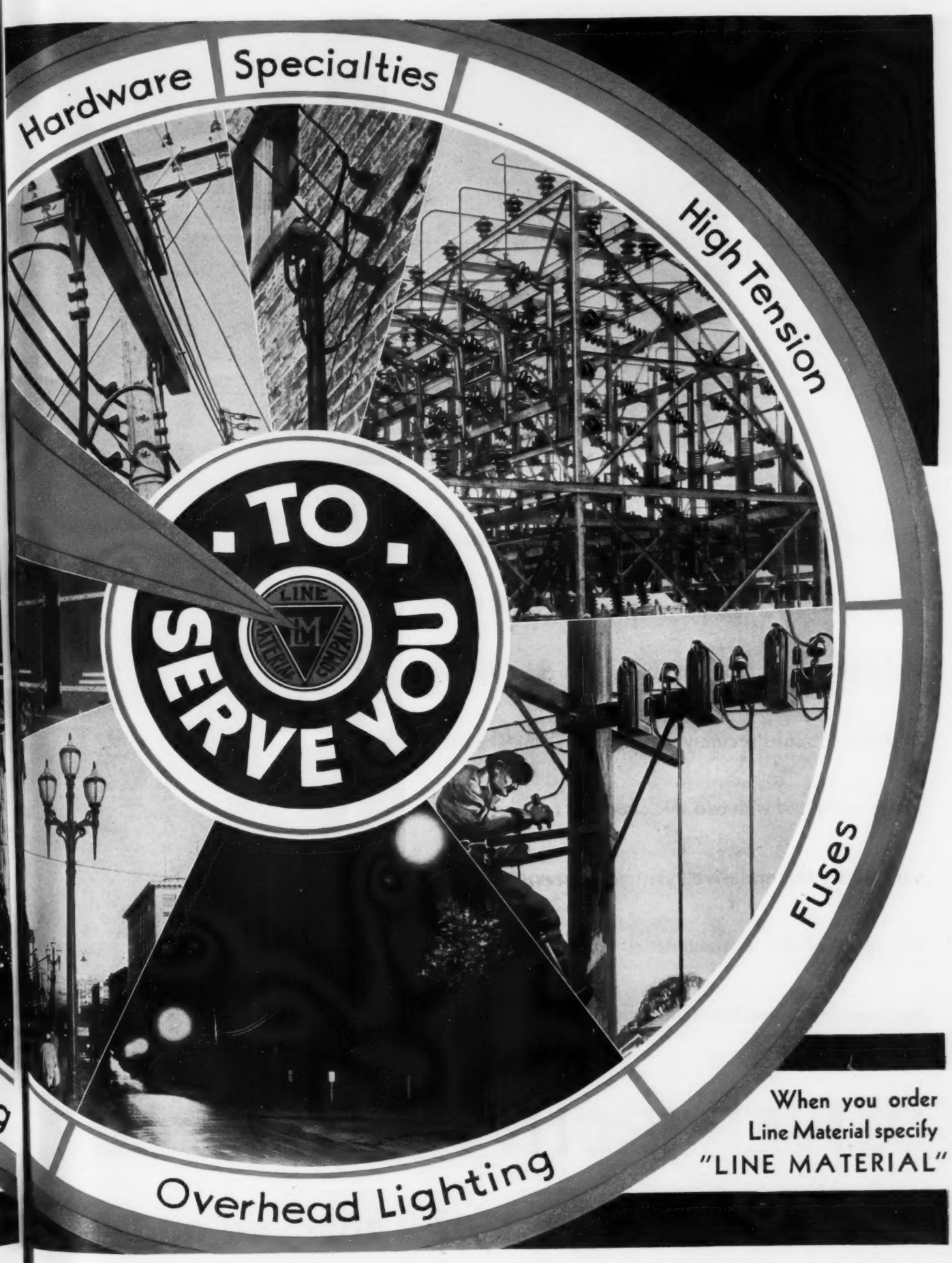
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When you order
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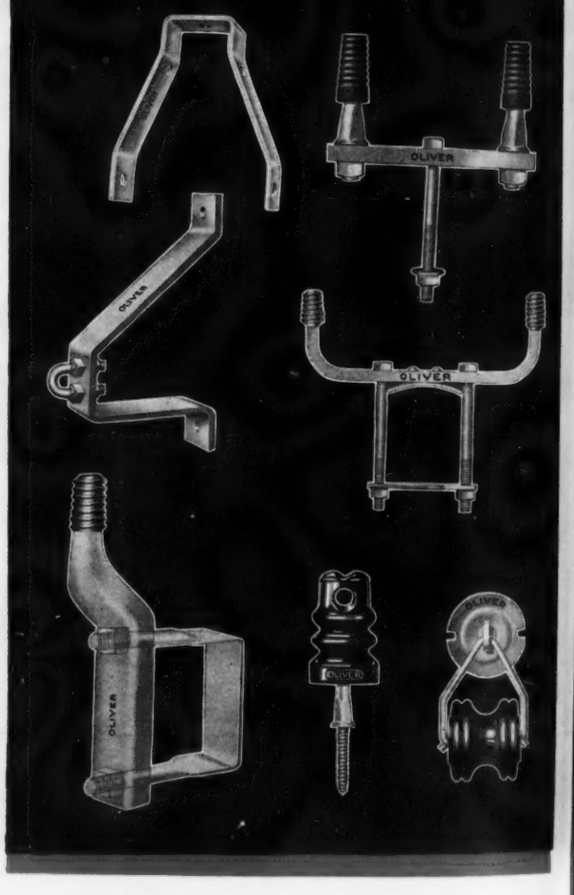
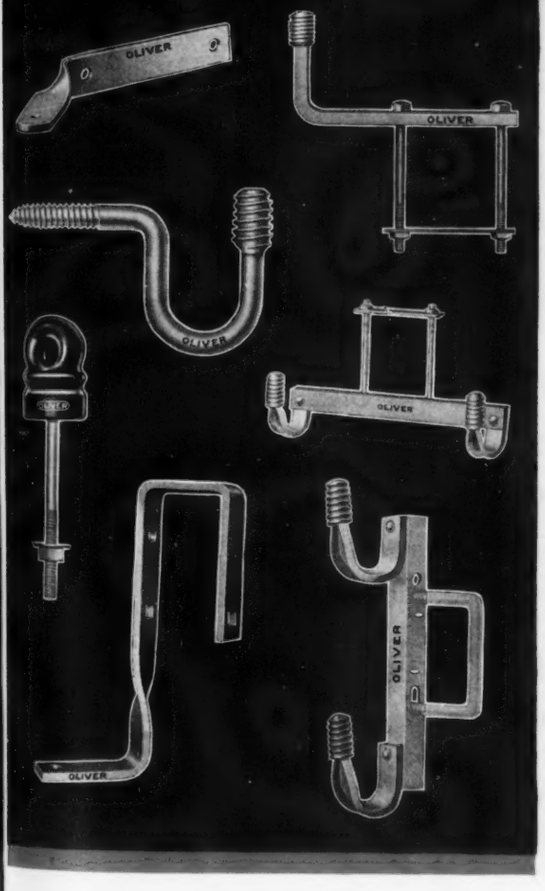
Extreme simplicity of design . . . correct to standard specifications to the n-th degree . . . every little twist and turn made exactly uniform . . . fastening clamps fit snugly . . . cobs securely attached . . . all metal parts super-protected with two thick coats of zinc, hot galvanized by the exclusive Fassinger process . . . these are some of the characteristics that make Oliver the preferred brackets throughout the industry.



OLIVER IRON AND STEEL COR

Manufacturers of Approved and Acc

VER
KET'S



The result of many years of specialization in pole line materials . . . made in the most modern, completely equipped plant devoted exclusively to the production of forged and threaded products of every description and shape. Here your every pole line requirement is satisfactorily met both in quality and quantity . . . here is readily available every standard bracket known to the pole line industry. Let us serve you.

PORATION, PITTSBURGH, PA.

epted Pole Line Materials Since 1894

P&H

Predetermined results through laboratory control of "P&H" operations

LEADERSHIP IN

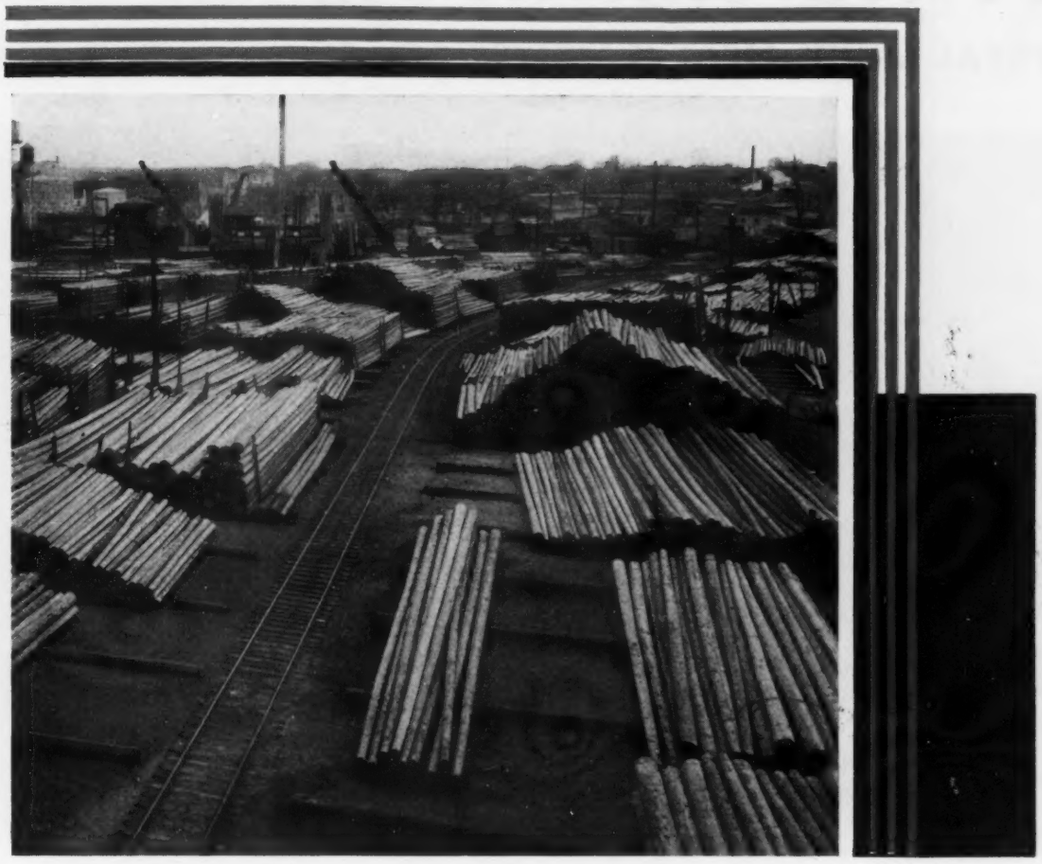
WHY have "P & H Process" Poles maintained a dominant position in every field of overhead transmission year after year? The answer is found in the following combination:

1. Laboratory control of all operations.
2. Skilled workmen who take pride in the high standard of "P & H" Pole quality.
3. Modern equipment all along the line, from woods operations to Butt-Treatment.
4. Proper handling to avoid damage and deterioration.
5. Yard sanitation to safeguard against conditions that start decay.

PAGE AND

MINNEAPOLIS, MINN.

THE POLE INDUSTRY



6. The distinctive "P & H Process" of Butt-Treatment, employing two patented features, making possible the unusual "P & H" guarantee.
7. An exacting system of inspection to eliminate every possibility of pole hazards and to make doubly sure that every "P & H Process" Pole measures up to the highest standards.
8. Fast Shipping Service on all cedar pole requirements—Northern White Cedar or Western Red Cedar.

Those are some of the reasons why "P & H" Poles are

"Still in the Lead"

HILL CO.

New York, N. Y., 50 Church St. Chicago, Ill., 20 North Wacker Drive Bldg.
Boston, Mass., 733 Public Service Bldg. Kansas City, Mo., 455 Dwight Bldg.
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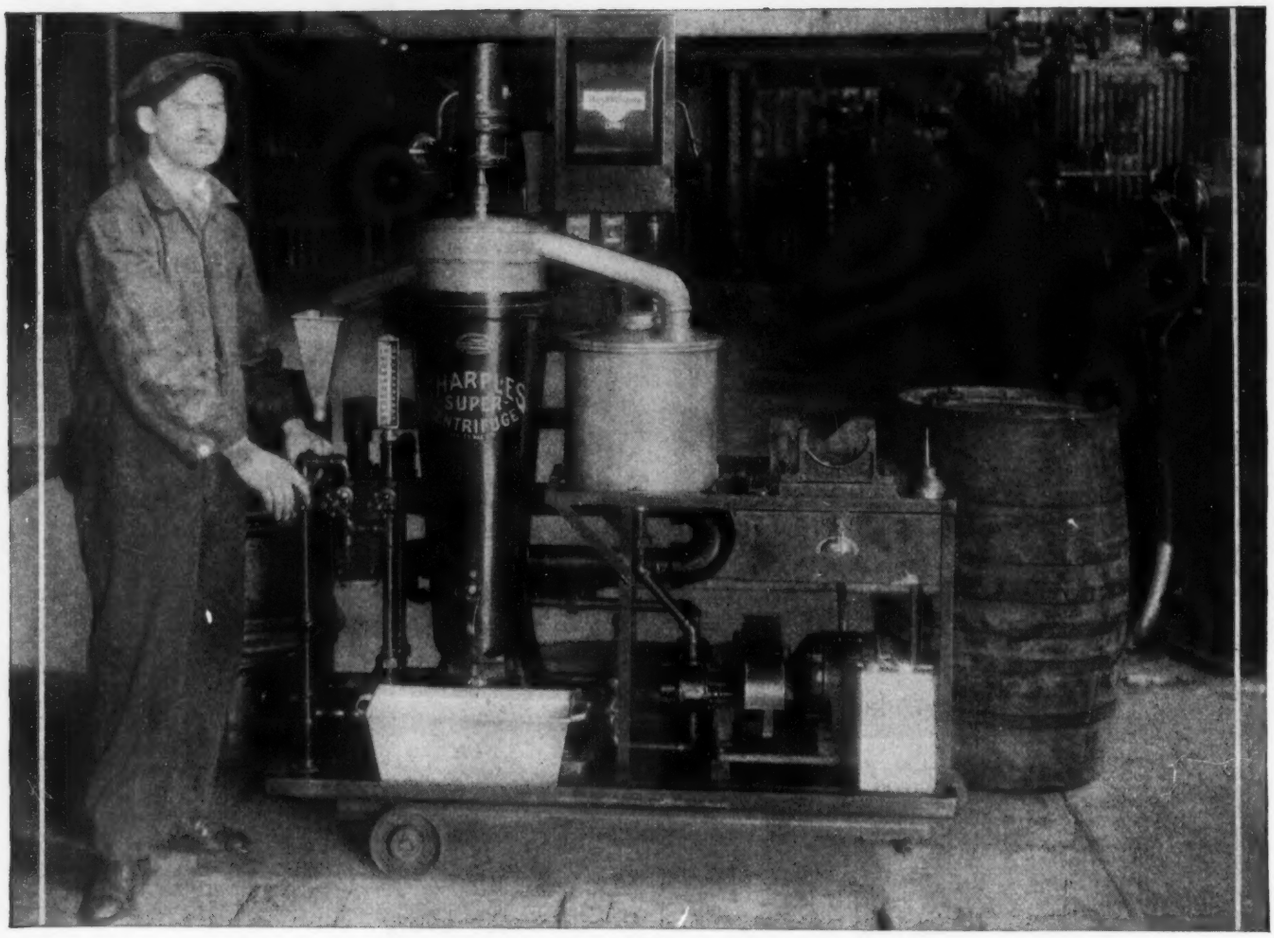
PURIFYING TRANSFORMER OIL

FOR MONTREAL LIGHT, HEAT & POWER CO., LTD., MONTREAL, QUE.



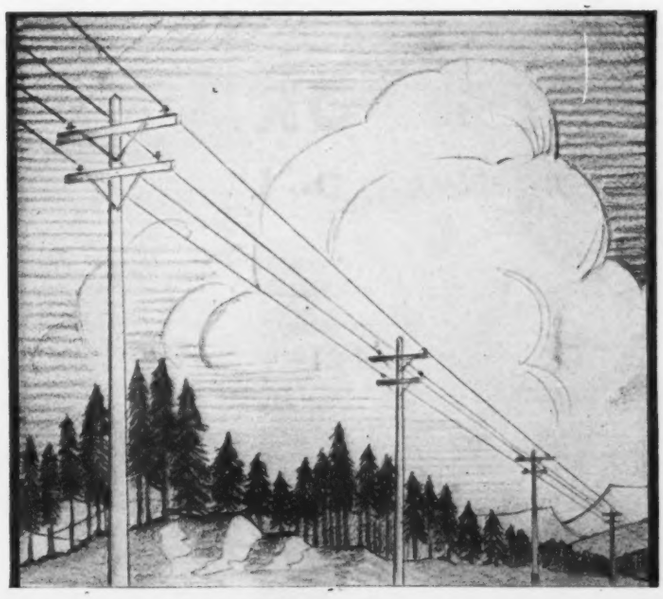
Unusually high dielectrics are secured by this Sharples Portable for the oil in the largest transformers on the system or for a drum of bad oil in the shop.

Sharples purifiers will produce more gallons of high dielectric oil per day because they are easy to start, easy to stop, easy to clean and develop the greatest centrifugal force available at high capacity. Complete data on request.

THE SHARPLES SPECIALTY COMPANY, 2314 WESTMORELAND STREET, PHILADELPHIA. Boston, New York, Pittsburgh, Chicago, Detroit, Tulsa, San Francisco, Los Angeles, Toronto. Factories in England and France.

SHARPLES

CENTRIFUGAL ENGINEERS • • PHILADELPHIA



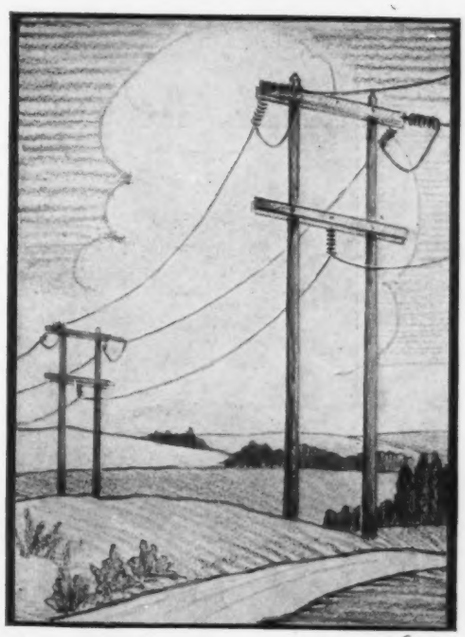
PARTRIDGE POLES

A PROVED POLE SERVICE

More important even than the many sterling qualities with which Nature endowed western red cedar is the fact that its success is proved. From years of experience the utilities know that cedar poles combine appearance, performance and lasting economy.

Avoiding competitive claims Partridge stands on a twenty-five year record of selecting good poles and preserving their natural merits by the best of handling and treating.

Leading utilities buying from Partridge get a proved product from an organization whose ability and performance likewise is proved.



T. M. Partridge Lumber Company
LUMBER EXCHANGE
Minneapolis, Minnesota

Distributed by
General Electric Supply Corp.
and
General Electric Merchandise Distributors

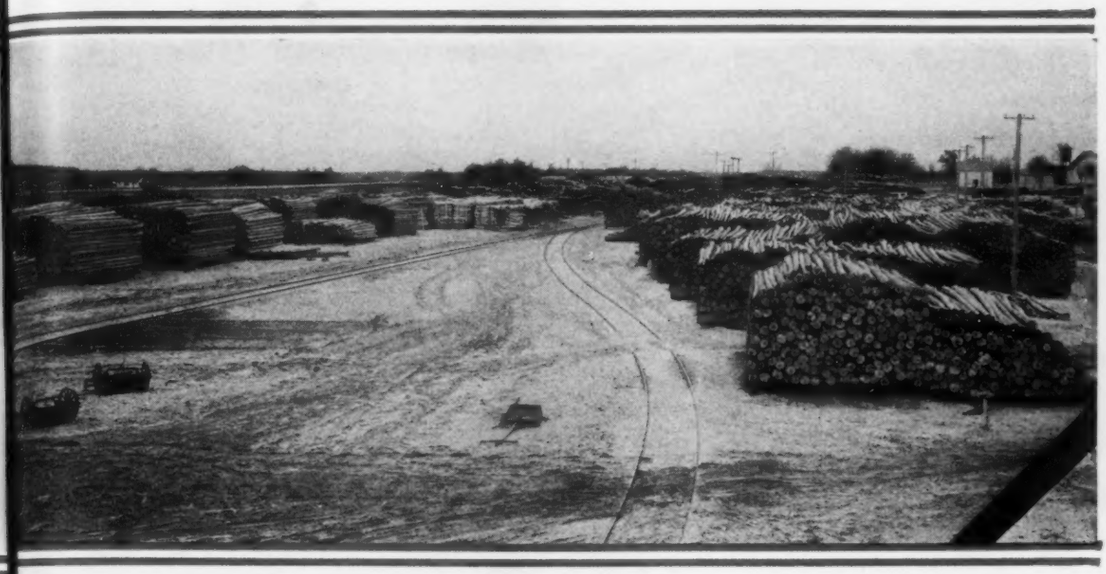
WESTERN RED AND NORTHERN WHITE CEDAR

The MacGillis & Gibbs Company

New York
220 Broadway

120 E. Wisconsin Ave.
Milwaukee, Wisconsin

Chicago
80 E. Jackson Blvd.



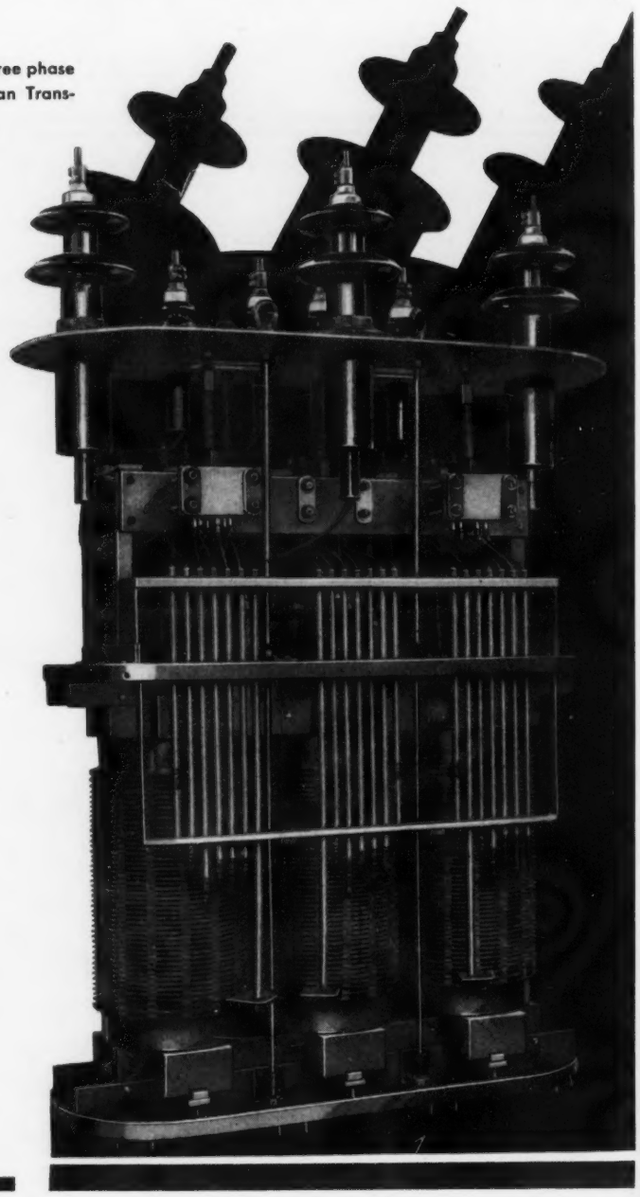
At your service

MacGillis stands ready to serve you today as never before. The rapid development of this company has necessitated an extensive increase in facilities. Its New Brighton Yard near Minneapolis, has been greatly enlarged within the year to keep pace with the continuous growth in business. Huge stocks of poles of all sizes are undergoing the seasoning process and waiting for your orders.

Two perforating machines and a treating plant with a capacity of 6 carloads daily ensure prompt shipment of orders. The best of electrically-driven tools are used for framing, roofing, and boring to your specifications in a minimum of time and at a minimum cost.

MacGillis' unexcelled service is causing more utilities every year to specify MacGillis Poles.

MacGillis Poles



Primary side of 750 kv-a. three phase 44,000-volt primary Kuhlman Transformer with tap changers.

WHEN transformers are being compared, workmanship is a factor that merits serious consideration.

This photograph indicates the quality and precision of Kuhlman workmanship. The organization is constantly reminded that this careful workmanship is as essential as the balanced design and excellent materials that go into Kuhlman Transformers.

The modern buildings, up to date equipment, pleasant and healthful working conditions are reflected in the workmanship of Kuhlman Transformers.

KUHLMAN ELECTRIC COMPANY, Bay City, Mich.

CAREFUL WORKMANSHIP

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Electric Supply Co.
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Industrial Power Equip. Co.
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Chicago, Ill.
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844 Rush St.

Cincinnati, Ohio
S. L. Currier
833 Union Trust Bldg.

Cleveland, Ohio
Public Service Supply Co.
627 Union Trust Bldg.

Dallas, Texas
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Denver, Colo.
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314 Tramway Bldg.

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10-230 General Motors Bldg.

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Wm. H. Fernholz
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Minneapolis, Minn.
Joseph L. Barnard
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W. O. Taylor & Co.
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New Orleans, La.
Lyman C. Reed
708-10 Girod St.

New York, N. Y.
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Parr Electric Export Corp.
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6315 N. 33rd St.

Philadelphia, Pa.
J. Edward Bolich
1015 Chestnut St.

Phoenix, Arizona
Frank C. Fassett
15 East Jackson St.

Pittsburgh, Pa.
Continental Sales & Eng. Co.
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Richmond, Va.
Edwin Wortham, Engineers
Box 910.

San Francisco, Cal.
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Call Building

Seattle, Wash.
Equipment Sales Co.
514 Lloyd Bldg.

Toledo, Ohio
Howard J. Wittman
612 Spitzer Bldg.

York, Pa.
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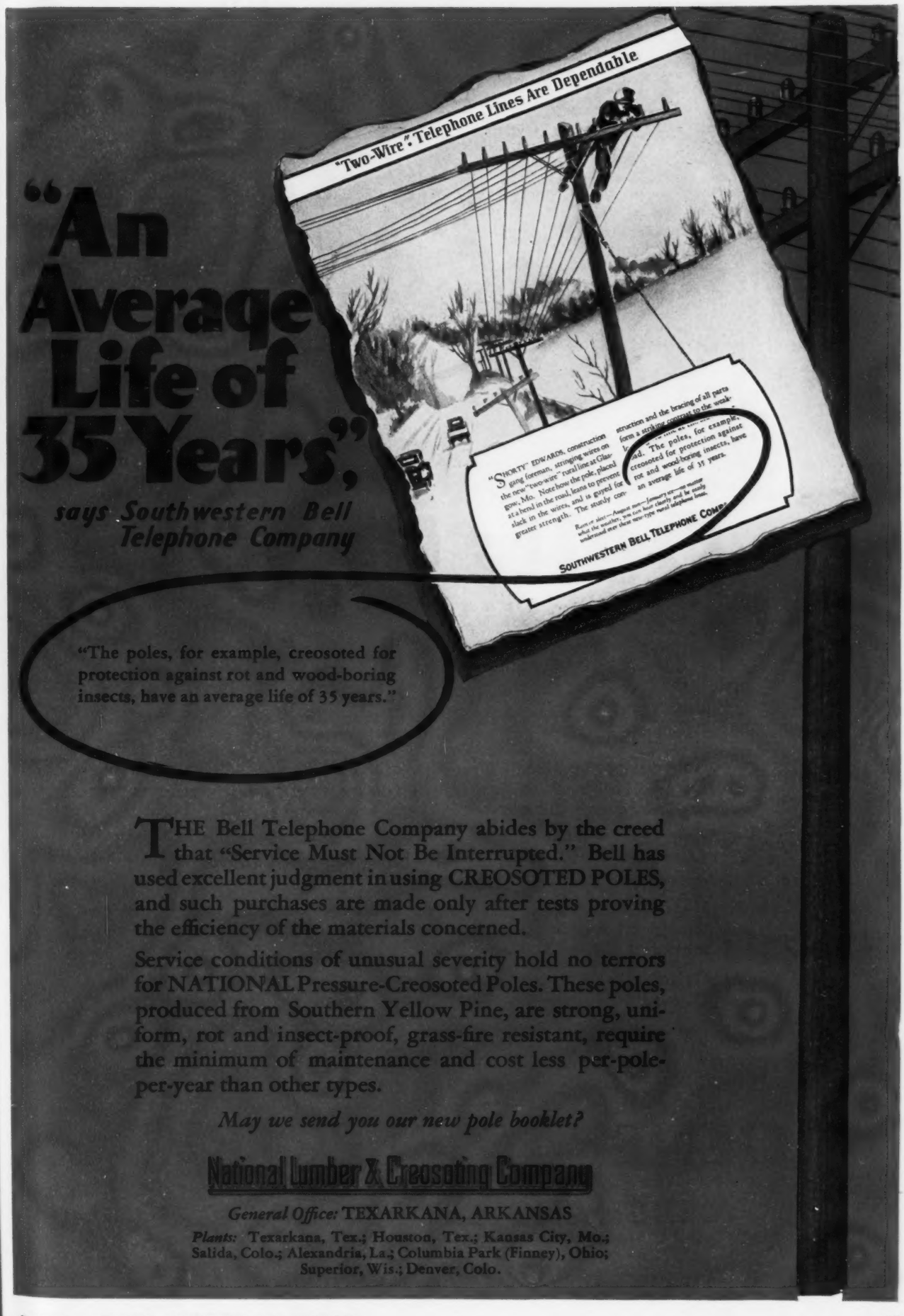
KUHLMAN TRANSFORMERS



"An Average Life of 35 Years," says Southwestern Bell Telephone Company

"The poles, for example, creosoted for protection against rot and wood-boring insects, have an average life of 35 years."

THE Bell Telephone Company abides by the creed that "Service Must Not Be Interrupted." Bell has used excellent judgment in using CREOSOTED POLES, and such purchases are made only after tests proving the efficiency of the materials concerned.

Service conditions of unusual severity hold no terrors for NATIONAL Pressure-Creosoted Poles. These poles, produced from Southern Yellow Pine, are strong, uniform, rot and insect-proof, grass-fire resistant, require the minimum of maintenance and cost less per-pole-per-year than other types.

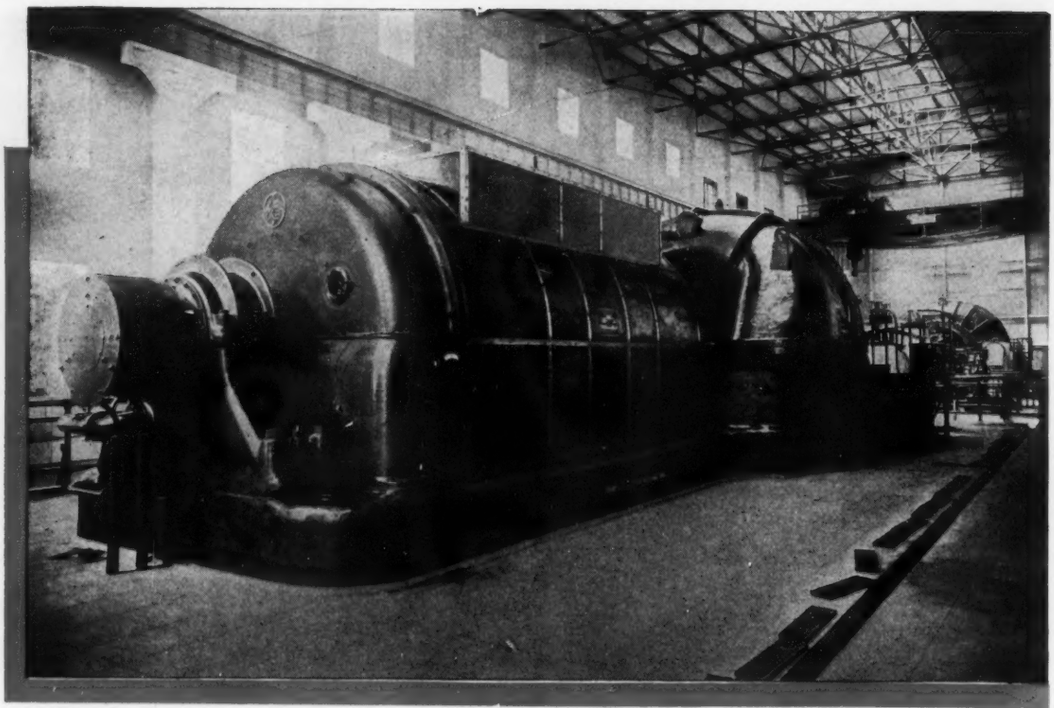
May we send you our new pole booklet?

National Lumber & Creosoting Company

General Office: TEXARKANA, ARKANSAS

Plants: Texarkana, Tex.; Houston, Tex.; Kansas City, Mo.; Salida, Colo.; Alexandria, La.; Columbia Park (Finney), Ohio; Superior, Wis.; Denver, Colo.

WHERE LOADS ARE HEAVY— WHERE LINES RUN HOT—



Deltabeston

(ASBESTOS INSULATED) STATION CABLE!

You can be sure station cable will stand terrific punishment—if it's DELTABESTON.

Heat has no effect on its *long-fiber* asbestos, filled with flame-proof compound . . . asbestos compactly *felted on* by the special Deltabeston process . . . two layers of it!

And it bears overloads! Many thicknesses of varnished tape—*each* good for more than 7000 volts without puncturing—*multiply* its dielectric strength.

Films of plastic compound make it flexible . . . insulation doesn't crack at the bends. A tight asbestos braid jacket saturated with compound seals it against oils, acids, steam, water.

Deltabeston Station Cable is armor against fire and breakdown. A General Electric product!

See it. We'll gladly send a sample and descriptive bulletin. Please write Section Y-399, Merchandise Department, General Electric Co., Bridgeport, Conn.

LONG-FIBER Asbestos for Deltabeston

Magnet Wire
Station Cable
Switchboard Wire
Motor Leads
Headlight Wire
Cab Cord
Stove Wire
Fixture Wire
Control Cable

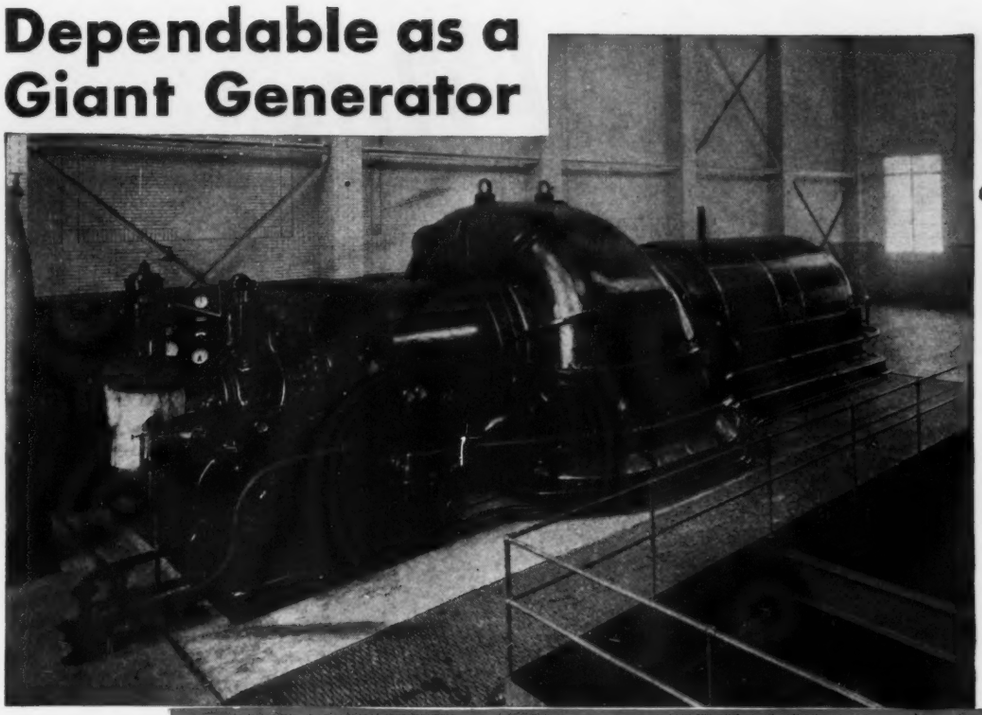
DELTABESTON WIRE

GENERAL ELECTRIC

MERCHANDISE PRODUCTS

MERCHANDISE DEPARTMENT · GENERAL ELECTRIC COMPANY · BRIDGEPORT, CONNECTICUT

Dependable as a Giant Generator



LONG-FIBER Asbestos on DELTABESTON

Magnet Wire
Station Cable
Switchboard Wire
Motor Leads
Headlight Wire
Cab Cord
Stove Wire
Fixture Wire
Control Cable

Deltabeston

(ASBESTOS INSULATED) CONTROL CABLE

Control lines *must* function—come what may. Recognizing this, General Electric offers you the new DELTABESTON Asbestos Insulated Control Cable . . . fit for *any* duty, anywhere . . . one more service safeguard.

It carries any desired number of conductors, each insulated with varnished cambric sealed in pure *long-fiber* asbestos compactly *felted-on* by the patented process used only by Deltabeston.

This bundle of rugged wires—in colors for your convenience—is jacketted in tough, tight asbestos braid . . . saturated to the copper with flame-proof compound.

Fire never can feed on *this* cable. Heat will not carbonize the asbestos insulation. Dielectric strength remains high. It's impervious to water, gases, oils, for years—permanent.

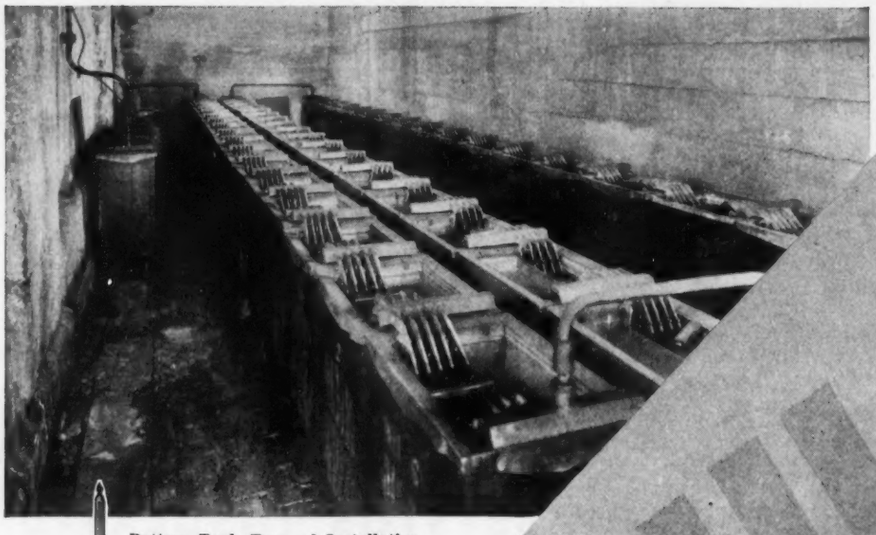
If you haven't seen this new cable, we'll gladly send you a sample. Write Section Y-399, Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

DELTABESTON CONTROL CABLE

MERCHANDISE DEPARTMENT - GENERAL ELECTRIC COMPANY - BRIDGEPORT, CONNECTICUT

"He had this : then he bought . . .



Battery Tank Type of Installation
Previously Used

PHILC
PROTE

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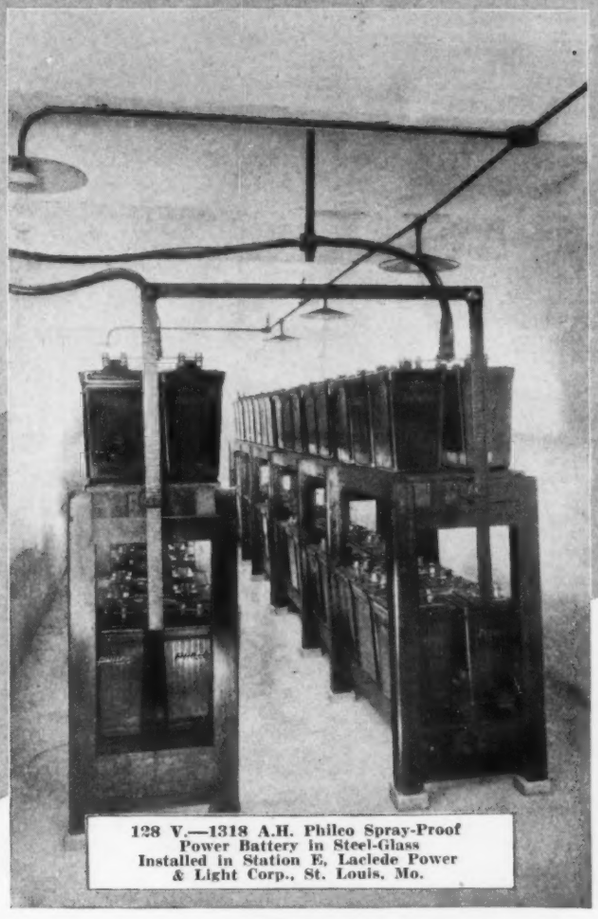
PHILADELPHIA STORAGE BATTERY COMPANY,

PHILCO"



128 V.—1318 A.H. Philco Spray-Proof Power Battery in Steel-Glass Installed in Station E, Laclede Power & Light Corp., St. Louis, Mo.

A Battery Replacement up before the Chief Engineer for Final Decision!

PLATE REPLACEMENT vs. PHILCO IN STEEL-GLASS?

Initial Tank and Installation figures plus Repair and Maintenance costs are compared with Battery Life—THEN the maintenance request for a Modern Spray-Proof Battery of *DOUBLE CAPACITY* occupying *LESS FLOOR SPACE.*

"69% of battery failures are due to inherent weaknesses of mechanical construction!"

From the Engineering Study on Philco—"Philco in Steel-Glass is the one Long Life Spray-Proof Battery of this size which can be shipped fully charged and arrive in perfect condition. This is possible only because of Steel-Glass and the Philco Super-Braced Construction."

—And so, Philco Protection insures the operation of another great station.

THE 11 POINTS TO PHILCO

1 STEEL-GLASS

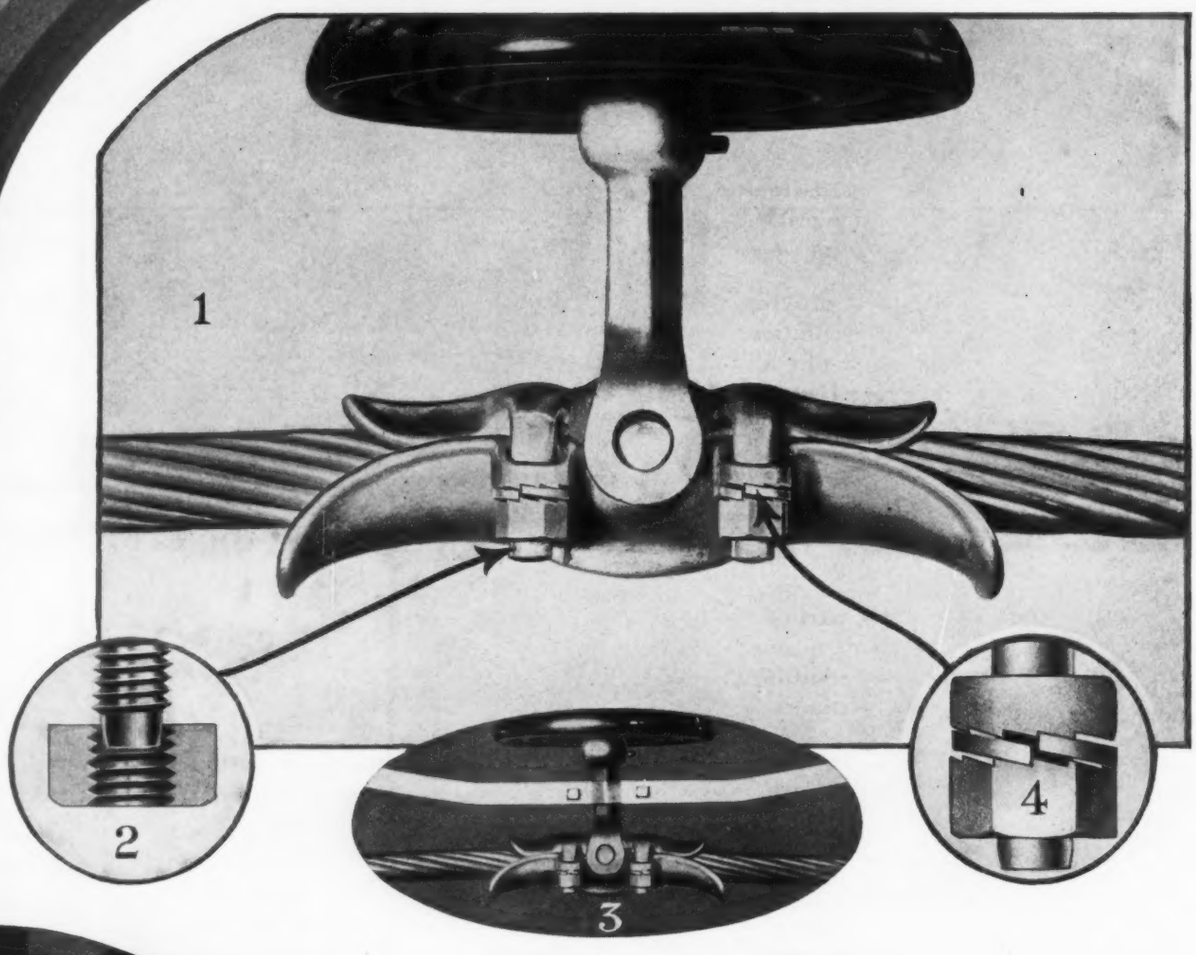
2 Corner and Side Locks.
3 Diamond Grids.
4 Philco Processed Plates.
5 Philco Slotted Retainers.
6 Quarter-Sawed Hard Wood Separators.
7 Spray-Proof Funnel Vents.
8 Built-in Charge Indicators and Thermometers.
9 Burned-Bolted Connectors.
10 Shipped Fully Charged.
11 Lowest Space Installation and Maintenance Cost.

PHILCO
DIAMOND GRID BATTERIES

ONTARIO and C STREETS, PHILADELPHIA, PA.

LAPP Trunnion Type

of Copper Bearing Forged Steel—



1—New LAPP Trunnion Type Suspension Clamp in use. 2—(section) Bolts have blank ends, enabling lineman to center the nut swiftly and accurately. 3—Showing method of making reliable attachment of any arc protective device to the clamp. 4—Faces of clamp body ear and nut are toothed, lock washer holding nut in positive engagement.

LAPP INSULATORS

LAPP INSULATOR CO. INC. LEROY·N.Y.·U.S.A.

Suspension Clamp

Improves Design—Simplifies Construction

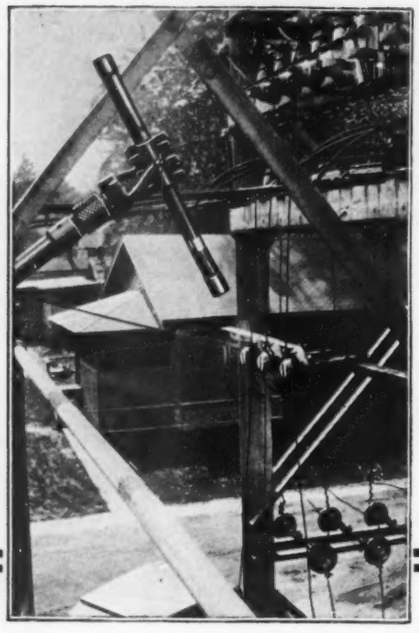
TRANSMISSION and Construction Engineers are finding in this new clamp an improved means of saving time in field construction and of reducing the cost of installation and upkeep. Note these significant features:

1. **An all forged steel clamp providing uniformity and strength with minimum weight.**
2. **The clamp moving about the center of oscillation permits the free passage of standing waves, minimizing the effects of vibration.**
3. **It is carefully designed to eliminate all surplus weight, producing an unusually light but very strong clamp.**
4. **The major part of the weight is concentrated near the center of oscillation, resulting in a low moment of inertia.**
5. **A high corona forming voltage, due to the smooth, rounded sections. There are no sharp corners projecting into the high intensity field to induce corona.**
6. **There is a minimum of parts—no loose U bolts or J bolts. All bolts forged integral with the keeper.**
7. **Lock washers used between serrated surfaces on the nut and clamp body ears positively lock the nuts, maintaining permanent tightness in spite of continued vibration.**
8. **Field construction is simplified by absence of loose parts, and accuracy assured by drop forgings.**
9. **A substantial ⅞" square section is provided for attaching any type arc protection devices—arcing hearts, horns, rings, etc.**
10. **A very slight modification converts this clamp into a simple positive trip clamp for releasing the conductor, requiring little or no field adjustment.**

These clamps are available for conductors ranging from ½" to 2½" diameter for both clevis type and ball and socket connection. You will be interested in the use of these Lapp trunnion clamps for supporting ground wires.

We invite your inquiries for our bulletin on these clamps and we will be glad to consult with you to aid in solving specific problems.

INSULATORS LAPP INSULATOR CO. INC. LEROY·N.Y.·U.S.A.



DON'T DE-ENERGIZE

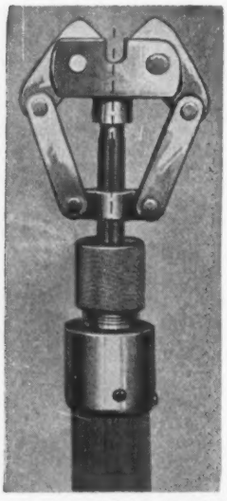
THE SYSTEM OR PARTS OF IT to do maintenance work

USE POWER-ON MAINTENANCE TOOLS

FOR HORIZONTAL TOOLS

The Transelectric Thread and Socket is an original and ingenious device which makes it possible to work high voltage with low voltage facility and safety. The thread and socket interchanges with 200 TRANS-ELECTRIC tools and fittings, comparing with an electrician's complete set.

POWER-ON Maintenance Tools enable you to standardize on one method—to obtain full economy—to realize positive safety, and to simplify and improve maintenance work.

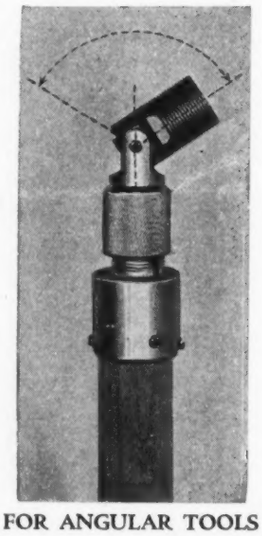


FOR VERTICAL TOOLS

Transelectric makes one design — The Handle Cap—as standard on both ends of various insulating Handles from 1 in. to 3 in. diameter and 2 ft. to 14 ft. length.

Transelectric POWER-ON Tools can be attached to every Insulating Handle and be operated from any angle, for any dimension, at any voltage and configuration.

Doing your very best is doing business with Transelectric.

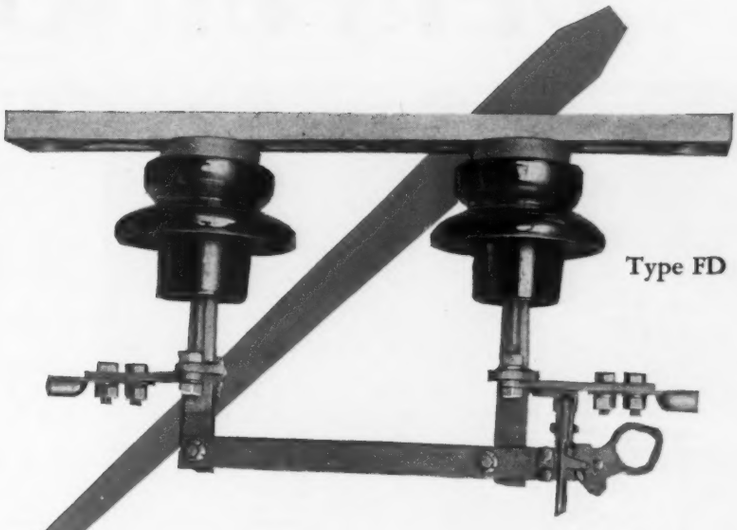


FOR ANGULAR TOOLS

TRANSELECTRIC COMPANY

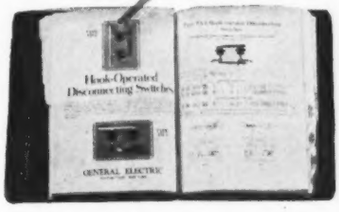
MANUFACTURERS OF POWER-ON EQUIPMENT

INDIANAPOLIS, U.S.A.



Type FD

NEW a moderate-duty moderately priced outdoor switch



For detailed information, refer to Publication GEA-1186

GENERAL Electric offers a hook-operated outdoor disconnecting switch with a rating of 15,000 volts, 200 amperes. The device is applicable to 6600-, 11,000-, and 13,200-volt circuits, and is arranged with slotted mounting holes in a channel-iron base to permit variation in cross-arm spacing.

It is available with or without blade latch, and is furnished with assembled insulator units which are comparable to line insulators with ratings of 22 kv.

The contact is of the tongue type, the blade consisting of two laminations of hard drawn switch copper. This produces consistently high contact pressure and provides high conductivity.

The Type FD conforms to the same standards which characterize other outdoor switching equipment of General Electric manufacture. It differs only in that it is of lighter construction—a moderate-duty switch at an economical price.

JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

500-45

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

PERFORMANCE ONLY

Over 100,000 Locke Grading Shields are in satisfactory service on the most important transmission systems in the country. ~ ~

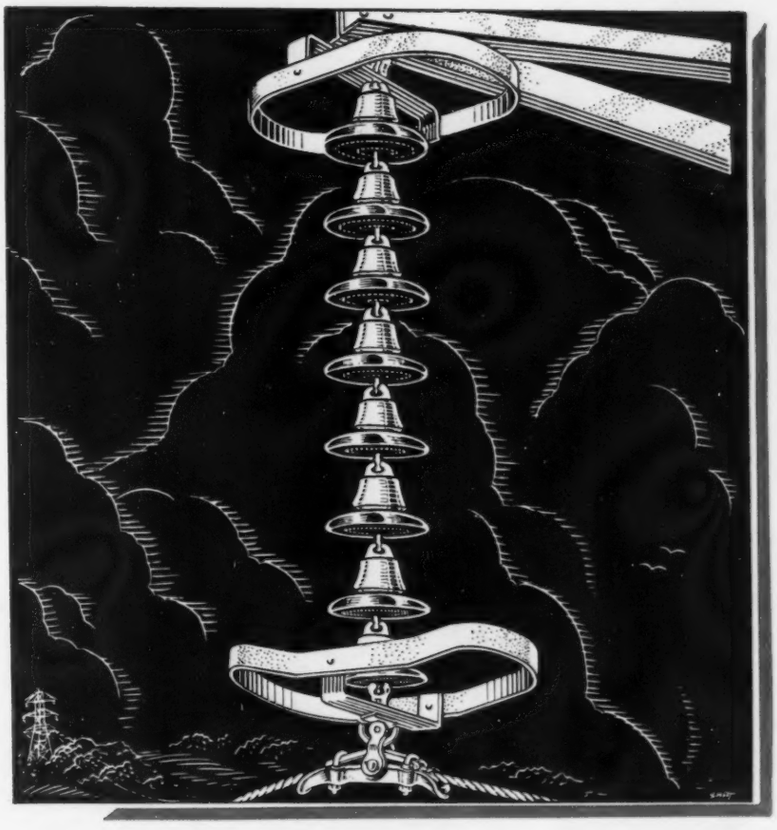
LOCKE ~ ~ ~ PORCELAIN ~ INSULATORS

IS THE MEASURE OF QUALITY

If you are already operating lines equipped with Locke Grading Shields you know how they minimize the hazards brought on by lightning. Records from the thousands of miles of transmission line so protected demonstrate their worth.

Locke Grading Shields raise the impulse flashover value of your insulator strings. They assure that when flashover does occur it will form clear of insulators and conductor. They provide a path about the string so that wind cannot blow the arc into the porcelain.

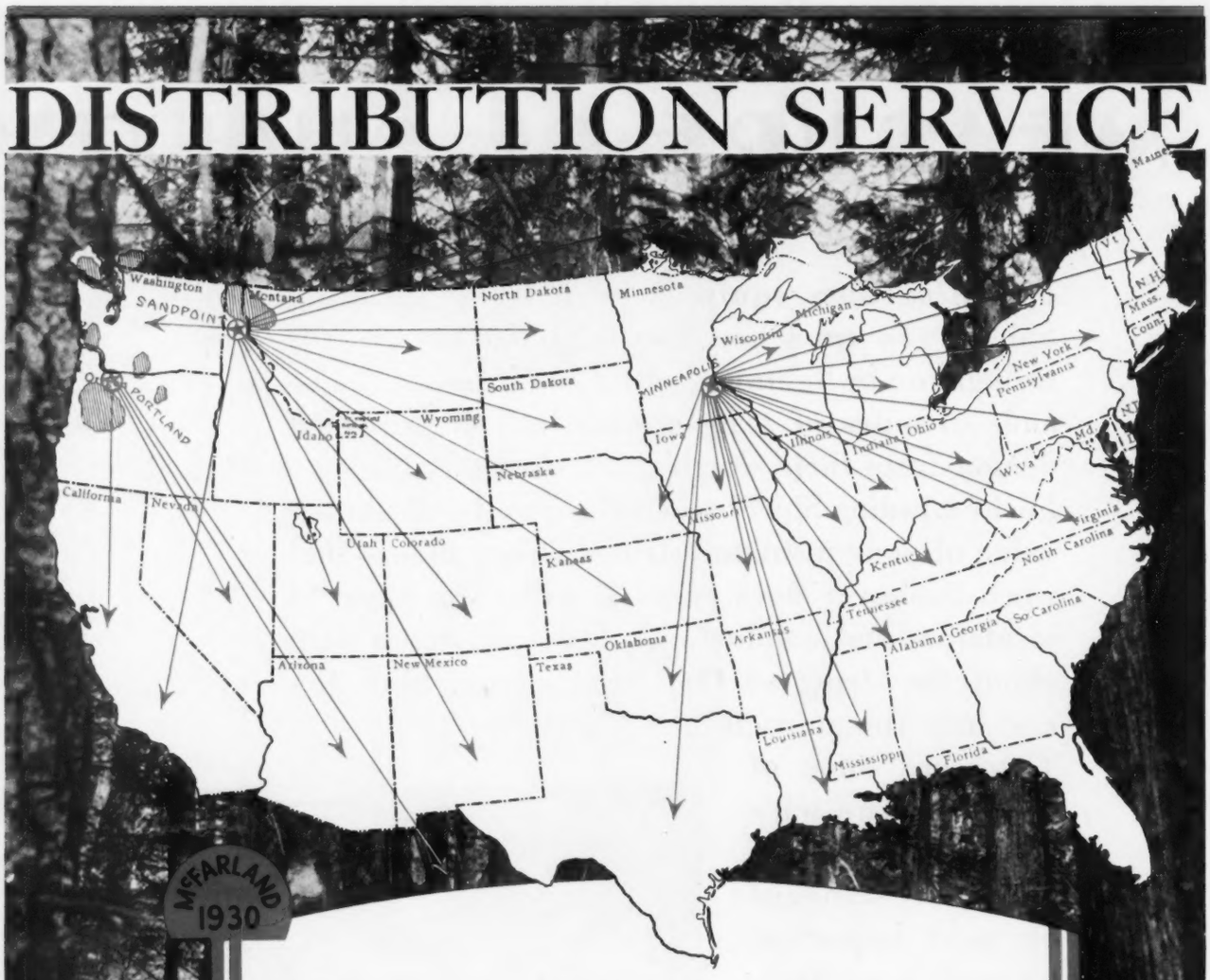
These are some of the reasons why Locke Grading Shields are standard on most important transmission lines.



A typical assembly. Locke Grading Shields are available for any type of insulator or construction.

LOCKE INSULATOR CORPORATION
BALTIMORE, MARYLAND

DISTRIBUTION SERVICE



With three strategically-located pole yards and PENTREX treating plants, McFarland offers a distribution service of national scope. Shaded areas show the 1930 producing operations of the McFarland company. Star circles show the three main yards and treating plants, each with adequate facilities and modern PENTREX equipment for producing quality cedar poles treated and framed to your specifications with economical delivery when and wherever you want them.

McFARLAND

WESTERN RED CEDAR POLES

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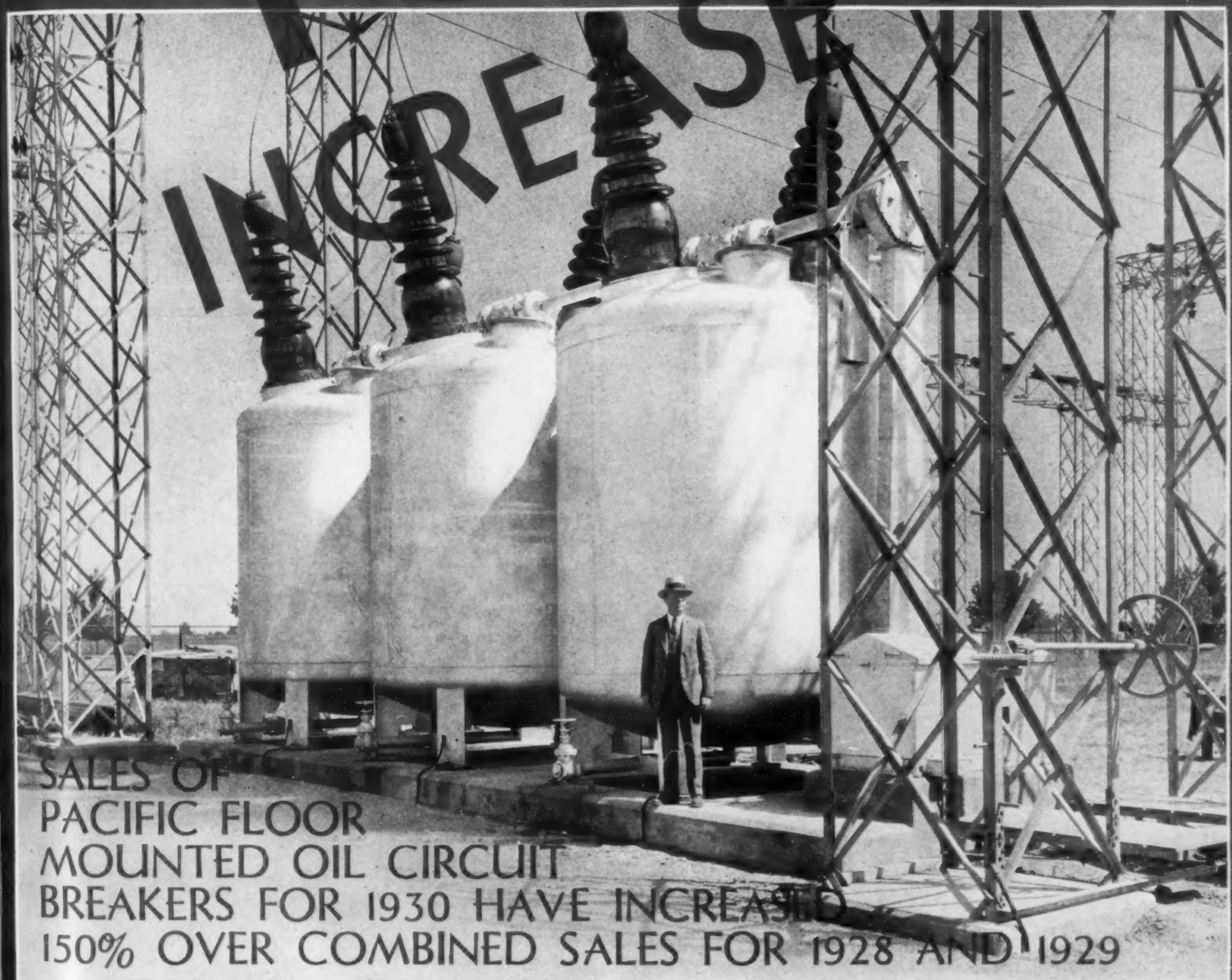
WORLD POWER CONFERENCE NUMBER

ELECTRICAL WORLD

JUNE 28, 1930
McGraw-Hill Publishing Company, Inc.
25 cents per copy

1930 INCREASE



SALES OF PACIFIC FLOOR MOUNTED OIL CIRCUIT BREAKERS FOR 1930 HAVE INCREASED 150% OVER COMBINED SALES FOR 1928 AND 1929

PACIFIC

230 K.V. OIL CIRCUIT BREAKER

PACIFIC ELECTRIC MFG. CORPORATION SAN FRANCISCO, CAL.

PACIFIC ELECTRIC MFG. CO.

OUTSTANDING FEATURES OF

Pacific Electric

FLOOR MOUNTED

Oil Circuit Breakers

Six Breaks in Series per phase

Welded Steel Tanks

Bakelite Rotating Units

High Speed Spring Type Motor Controls

Horizontal Blade

Reduces Arc and Gas Bubbles

Few Moving Parts

Simple in design, ruggedly constructed, accurately machined and permanently adjusted

Roller Bearing Equipped Bevel Gear Assembly with Concentric Oil Dash Pot for Pacific Floor Mounted Oil Circuit Breakers

TIMKEN BEARING EQUIPPED

Pacific Electric Manufacturing Corp.

Bay View, San Francisco, Calif. Dunes Highway, Gary, Indiana

BONE BUTTONS

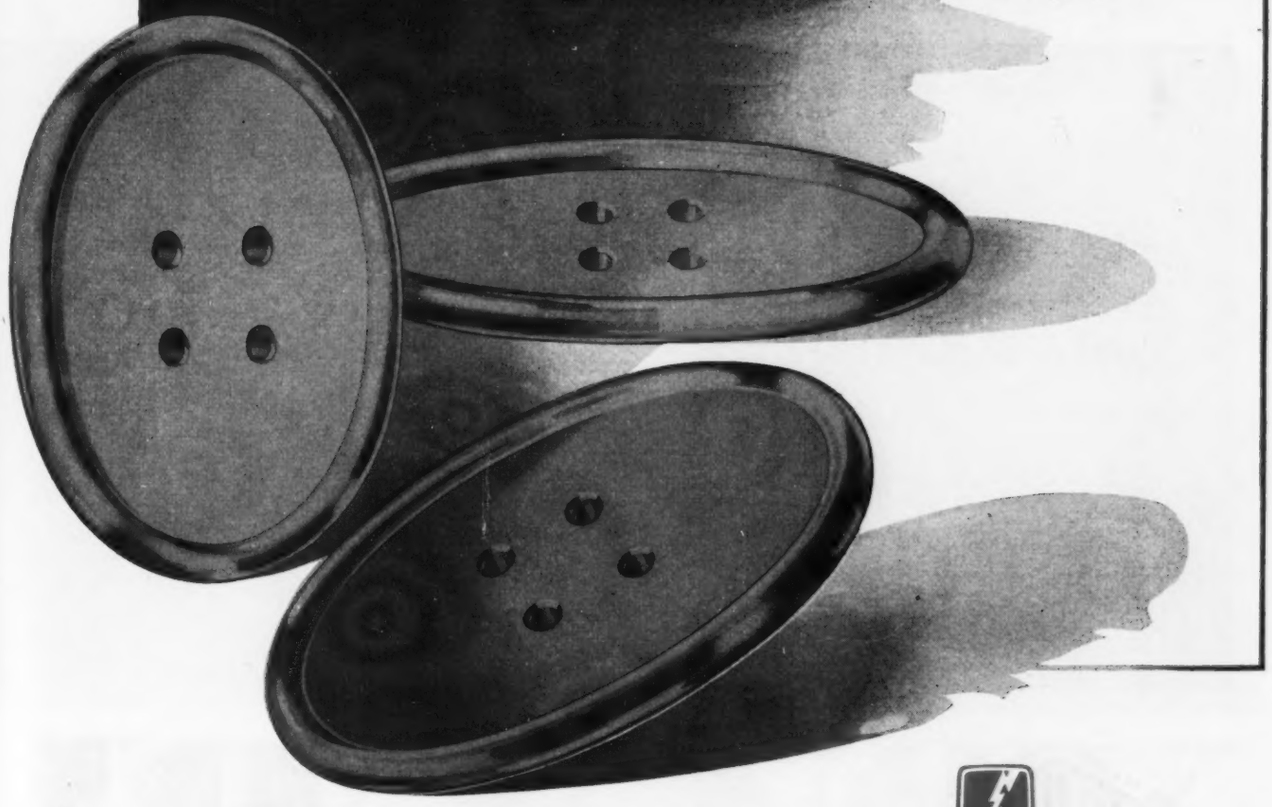
It is required that all linemen on duty wear clothing with non-metallic buttons or fasteners, so that chance contact with charged conductors is not aided by the presence of metal.

Insignificant things, these buttons, except under certain conditions, when an emergency arises and a life hangs in the balance. It is then that BONE BUTTONS save life and property.

So also it is true that users of HUBBARD POLE LINE HARDWARE find the life of their lines prolonged, and money saved by the super-resistance of Hubbard Hot Double-Dip Galvanizing to those forces with which it is so difficult to cope—the ravages of time. After years of exposure when ordinary galvanizing would have gone to dust, that insignificant extra thickness of zinc on the Hubbard Product keeps the pole line serving faithfully.

HUBBARD HARDWARE AND PEIRCE SPECIALTIES

"Built to Enjoy Bad Weather"



Hubbard and COMPANY

PITTSBURGH • OAKLAND, CAL. • CHICAGO

This improved type of single circuit tower has many desirable features. The lower portion is square and all four faces are alike. This is not only a very efficient method of distributing the broken wire load to the foundations, but it allows the use of variable legs and body extensions, which is the most economical method of increasing the height of a tower or taking care of the difference in elevation of the ground line at the corners of a tower.

In Fig. 1 is shown a tower with four standard legs, used on level ground.

Fig. 2 shows a tower with two 5′ shorter and two 5′ longer legs, making a tower of standard mean height suitable for use on a side hill. If the slope is greater a 10′ longer leg can be used in place of the 5′ longer.

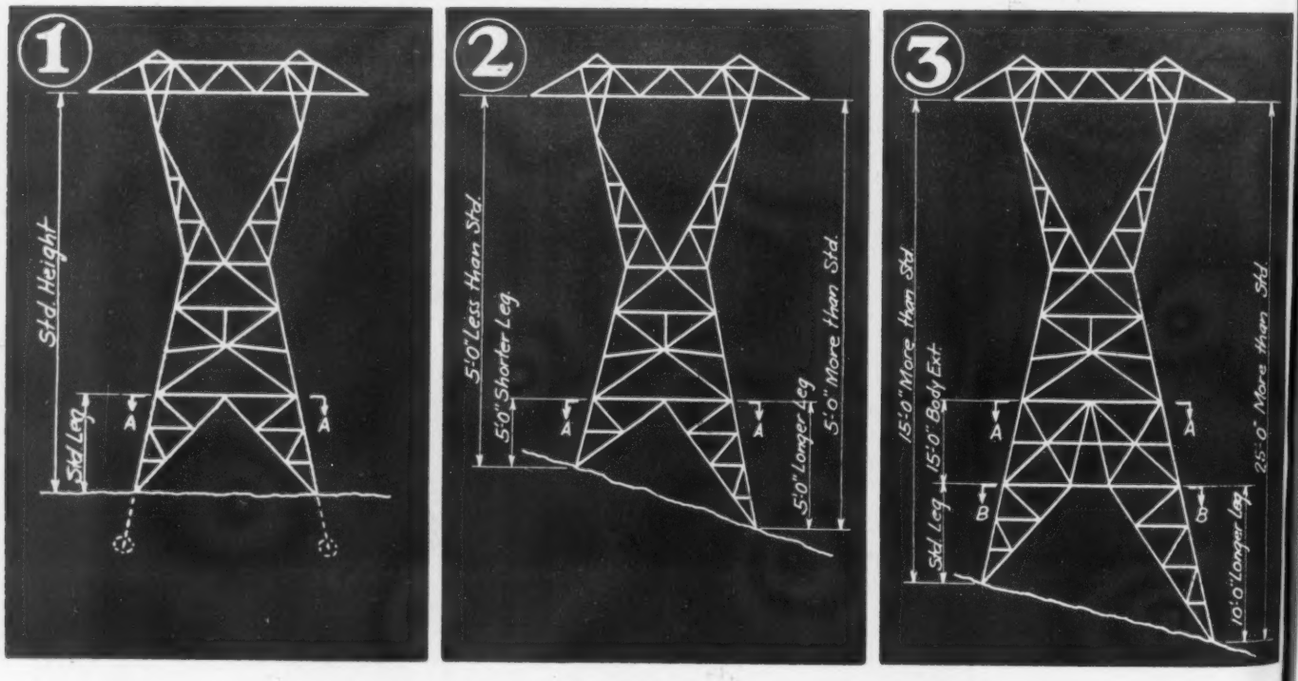
As the legs are entirely independent of each other any combination of legs can be used on the same tower. This eliminates most of the leveling necessary for the tower site. Which ever one of the four length legs best fits the particular location can be used without penalizing the construction in any way.

If a tower 15′ higher than normal is required the body extension as shown in Fig. 3 is inserted and the same legs used on the bottom thereof. This extension can also be used with any combination of the legs. The 15′ body extension used with four 10′ longer legs gives a tower 25′ higher than normal.

Figs. 4, 5, and 6 show the variable legs and body extension construction as applied to a standard two circuit tower. With these different length legs and body extension, towers varying in height by 5′ can be obtained from 5′ less than standard to 25′ more, making a total variation of 30′ in height. This will normally take care of all necessary requirements. If conditions justify the legs may be varied in smaller increments than 5 feet.

The variable legs together with the horizontal struts and horizontal cross bracing at sections AA and BB are assembled in place as a templet for setting the anchors; these parts are shipped with the anchors and once assembled are left in place. The carrying about of a special templet is unnecessary.

The narrow waisted and body extension constructions are patented.



TRADE MARK REG. U.S. PAT. OFFICE
BLAW-KNOX

Manufacturers of Blaw-Knox Electroforged Steel Grating and Stair Treads

BL

TOWERS

Adjustable

BLAW-KNOX COMPANY

2013 Farmers Bank Building, Pittsburgh, Pa.

New York	Philadelphia	Cleveland
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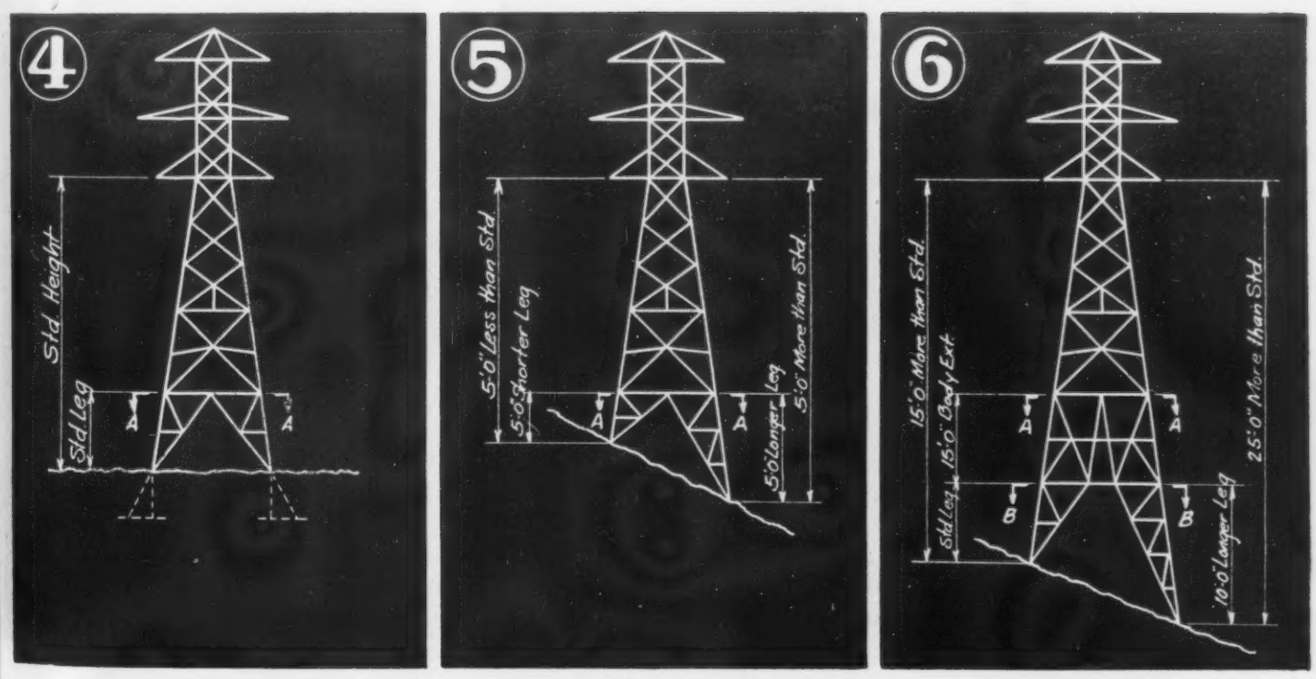
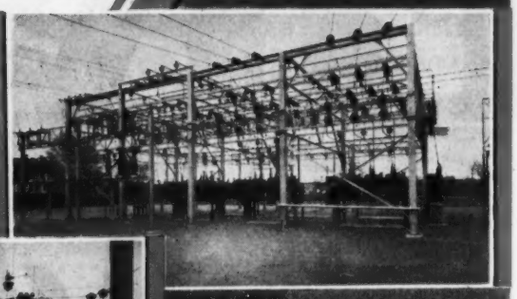
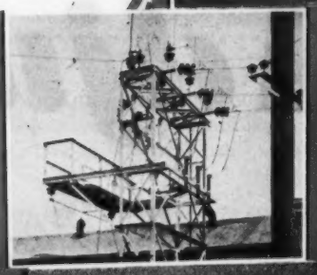
Dusseldorf, Germany, 17 Bismarckstrasse.

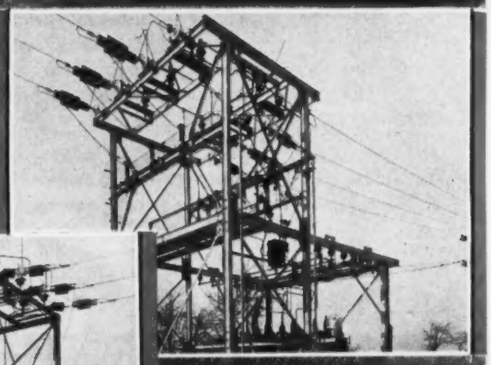


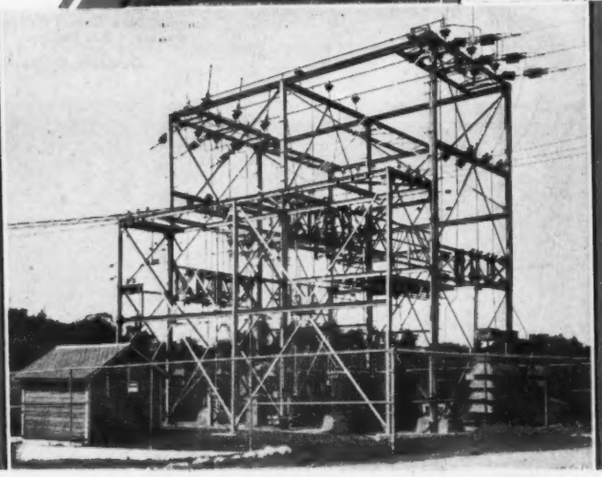
BLAW-KNOX

R&IE Cost *is always consistent with* R&IE *quality*









LOW PRICE or LOW COST?

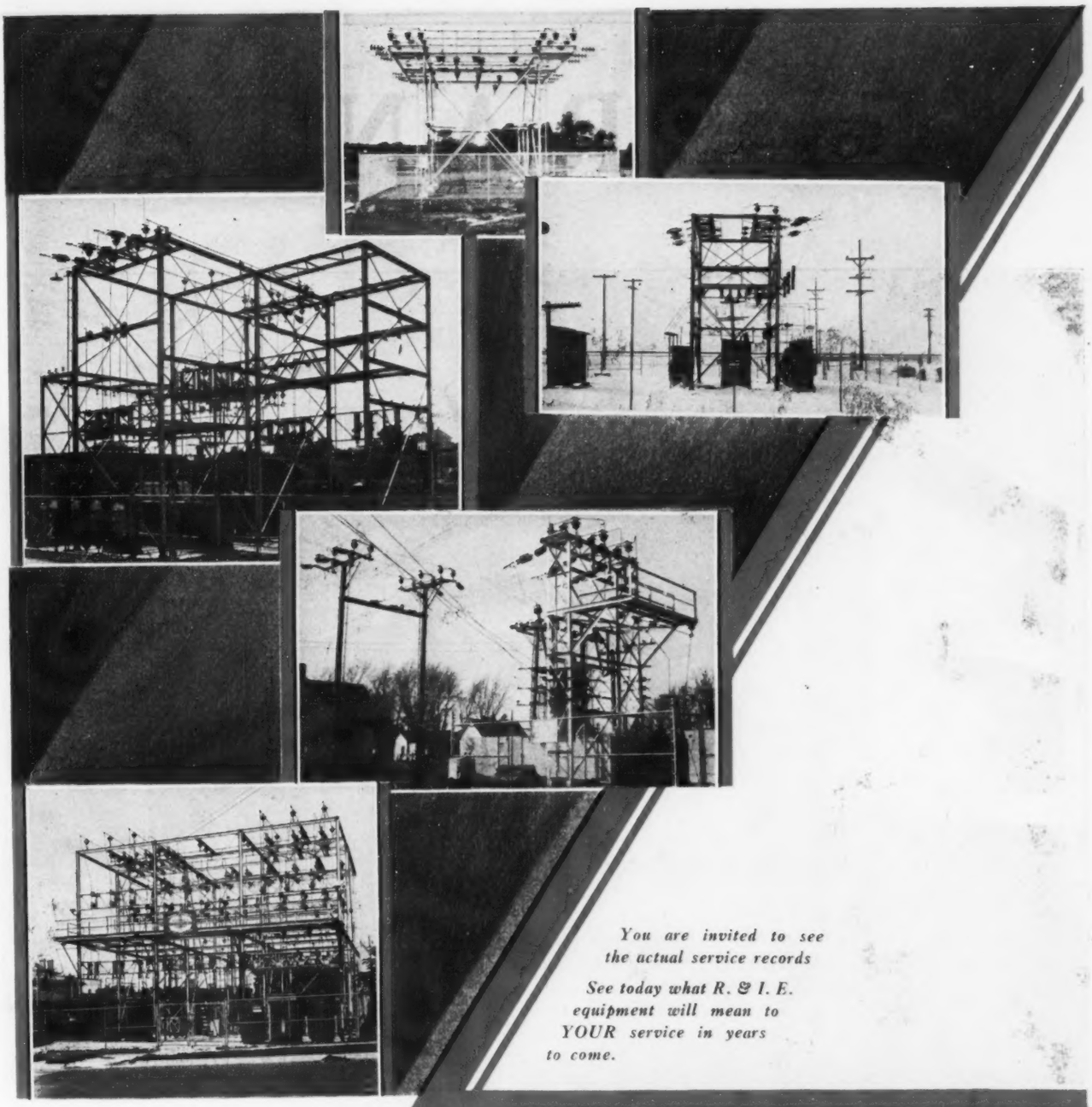
Do you distinguish between them?

Low Price means a compromise in the quality of some essential—workmanship, material or service. R. & I. E. equipment is NOT low price equipment.

Low Cost is different. The combination of superior design, material and workmanship results in a noteworthy saving over a period of years because breakage and necessary adjustments are eliminated.

R. & I. E. builds Low Cost Switching Equipment usually higher in price, but always cheaper to install and less expensive to maintain.

RAILWAY AND INDUSTRIAL
ENGINEERING CO. . . . . GREENSBURG, PA.



You are invited to see the actual service records

See today what R. & I. E. equipment will mean to YOUR service in years to come.

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Seattle
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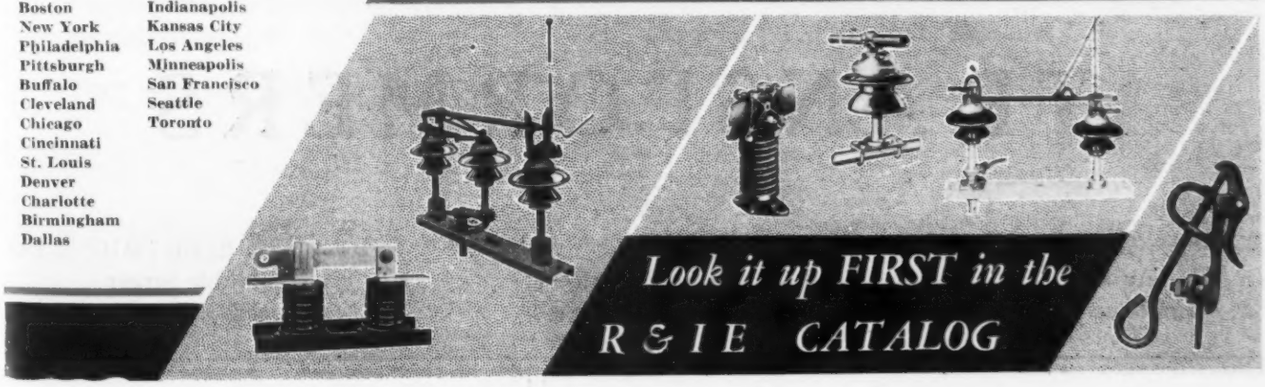
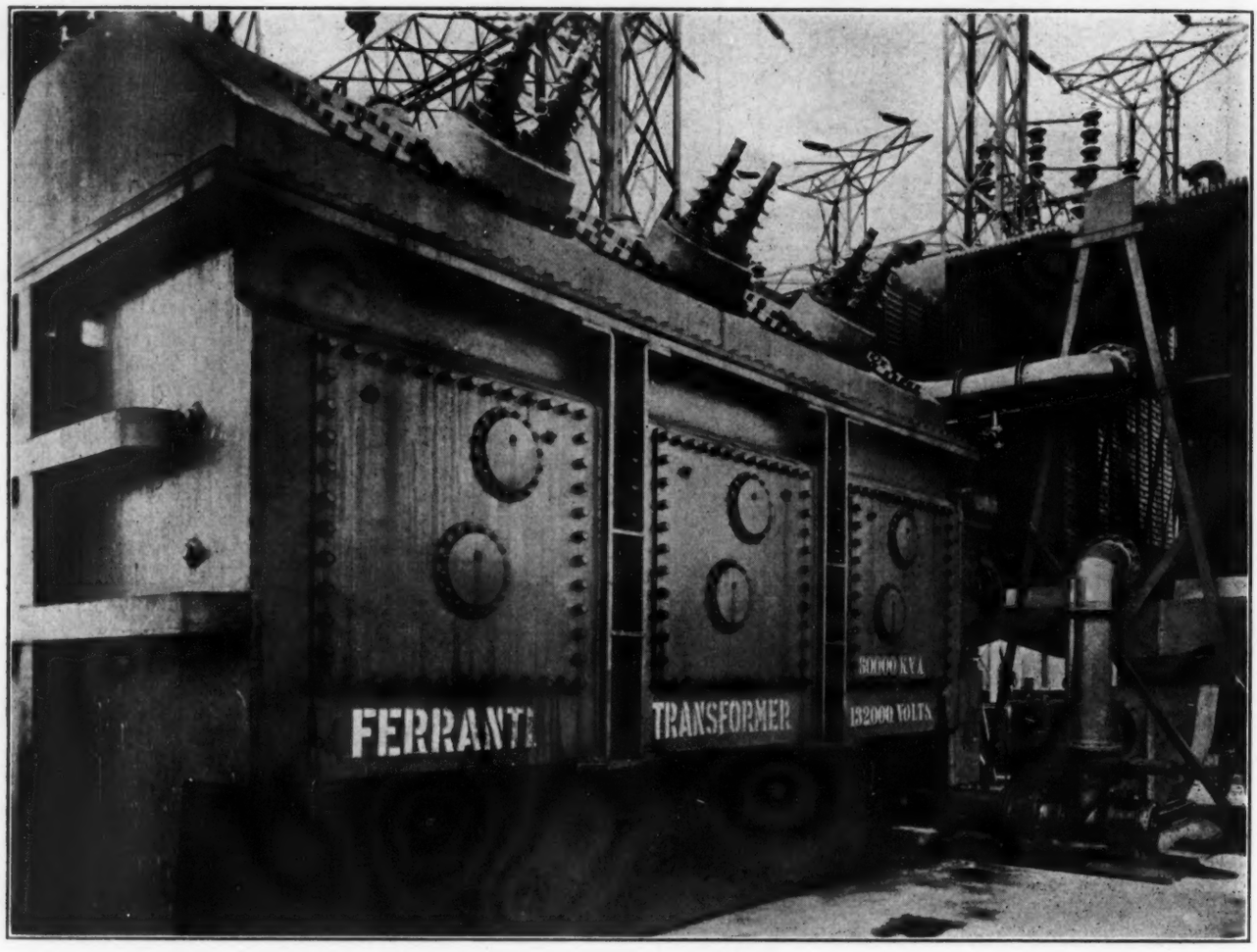


FERRANTI



60,000 KV-A. 132 KV. Three-Phase Transformer
Erected at Willesden, England

TRANSFORMERS

FERRANTI, LTD.
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FERRANTI ELECTRIC, LTD.
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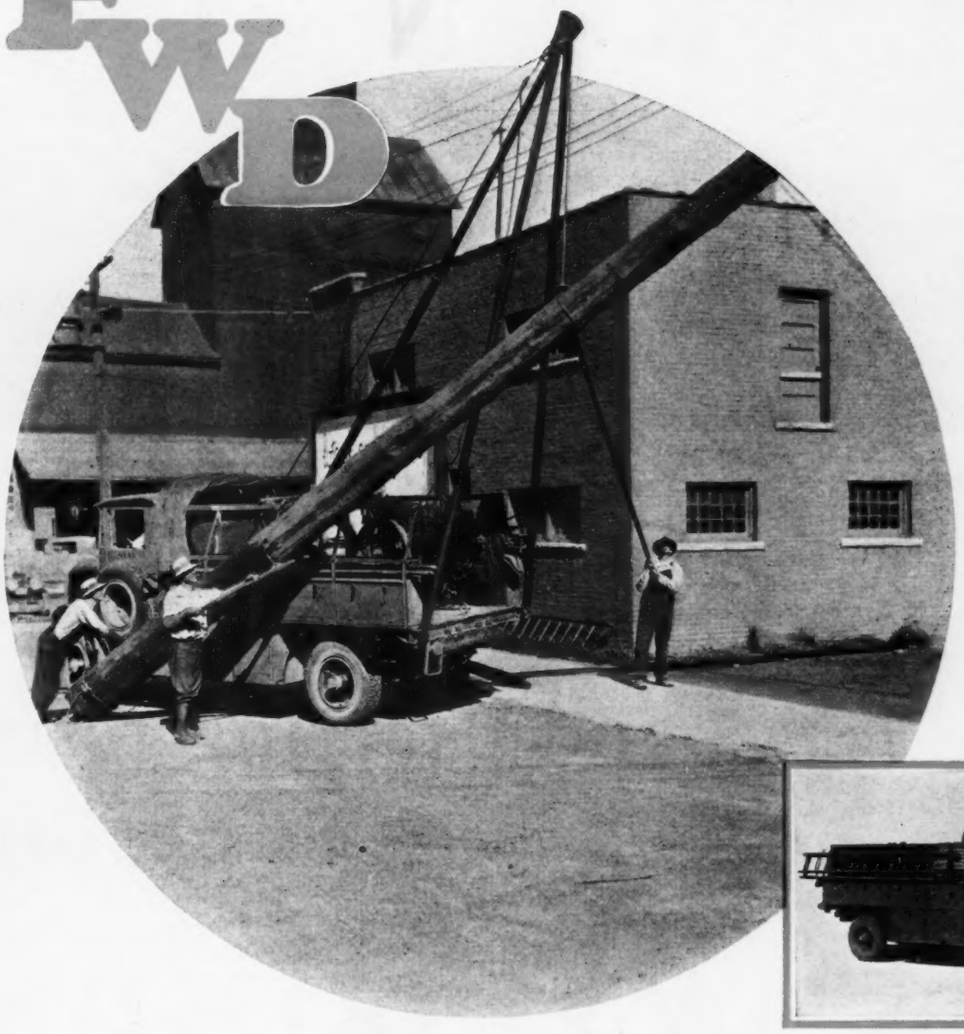
FWD MORE than a Truck



Drives through front and rear wheels, brakes on all four wheels.

Steers as easily as a pleasure car.

A general service truck which adapts itself to special needs and provides more than economical transportation.

Furnished in 2 to 10 ton sizes, including four wheel, six wheel and tractor trucks.

Manufactured by the oldest and largest manufacturer of four wheel drive trucks in the world.

Have increased in sales 1084% in the past eight years.

Received 62% of 1929 orders from owners of FWD Trucks.

OUR *live* wheels—to grip and pull FWD's through the toughest kind of going, and under *capacity* loads! Four *live* wheels—to speed FWD's over any kind of road swiftly and with real transportation savings! The FWD principle of distribution of power and pull on all four wheels gives *positive traction, extra speed,* and *cuts hauling costs.*

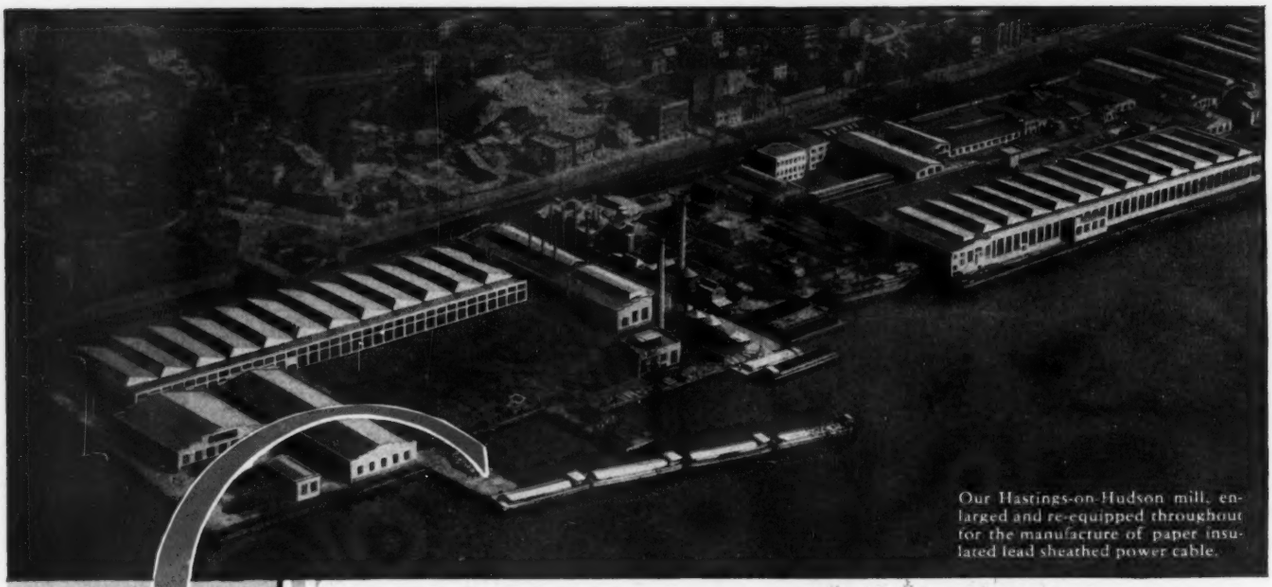
Because of the Four Wheel Drive principle, FWD Trucks provide reliable, economical transportation—either for hauling over hard surfaced roads or for heavy duty jobs in mud, sand or snow. They are ideal for public utility and telephone work.

Let us send you bulletins describing FWD Trucks in detail particularly those adaptable to your kind of work. Write today!

THE FOUR WHEEL DRIVE AUTO COMPANY, Clintonville, Wisconsin

CANADIAN FACTORY — KITCHENER, ONTARIO

BACKED BY NATION FWD WIDE SERVICE TRUCKS



Our Hastings-on-Hudson mill, enlarged and re-equipped throughout for the manufacture of paper insulated lead sheathed power cable.

Careful

and exacting tests Superior

ANACONDA

SCIENTIFIC accuracy removes the "guess" entirely, in the manufacture of Anaconda Paper Insulated Lead Sheathed Power Cable. From raw materials to finished reels, physical, chemical and electrical tests safeguard quality during every step of manufacture.

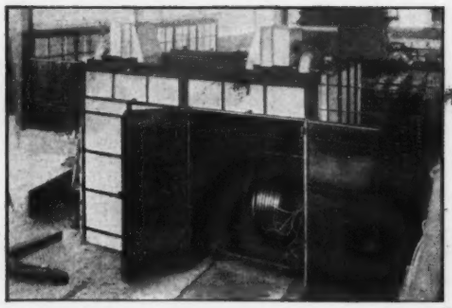
All materials must withstand severe analyses. Oil from storage tanks is tested daily for physical fitness. During the drying and impregnating process*, sensitive instruments record the electrical condition of every reel of cable.

*Taylor patented process.

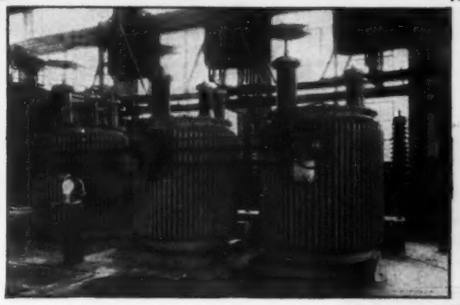
ANACONDA WIRE

General Offices: 25 Broadway, New York City

Sales Offices in



Dielectric loss oven and full reel on test.



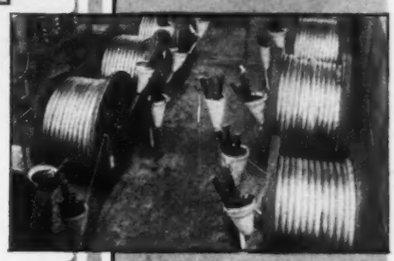
Transformers for routine testing of full reel lengths.

ANACONDA
from mine to consumer
REG. U.S. PAT. OFF.

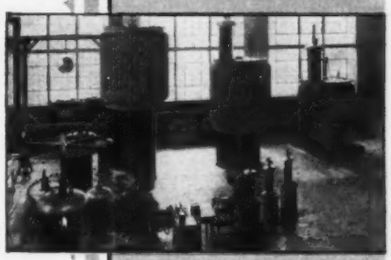
analyses

help safeguard the Quality of

POWER CABLE



Full reels of power cable in testing bay.



Transformers for use in power cable research.

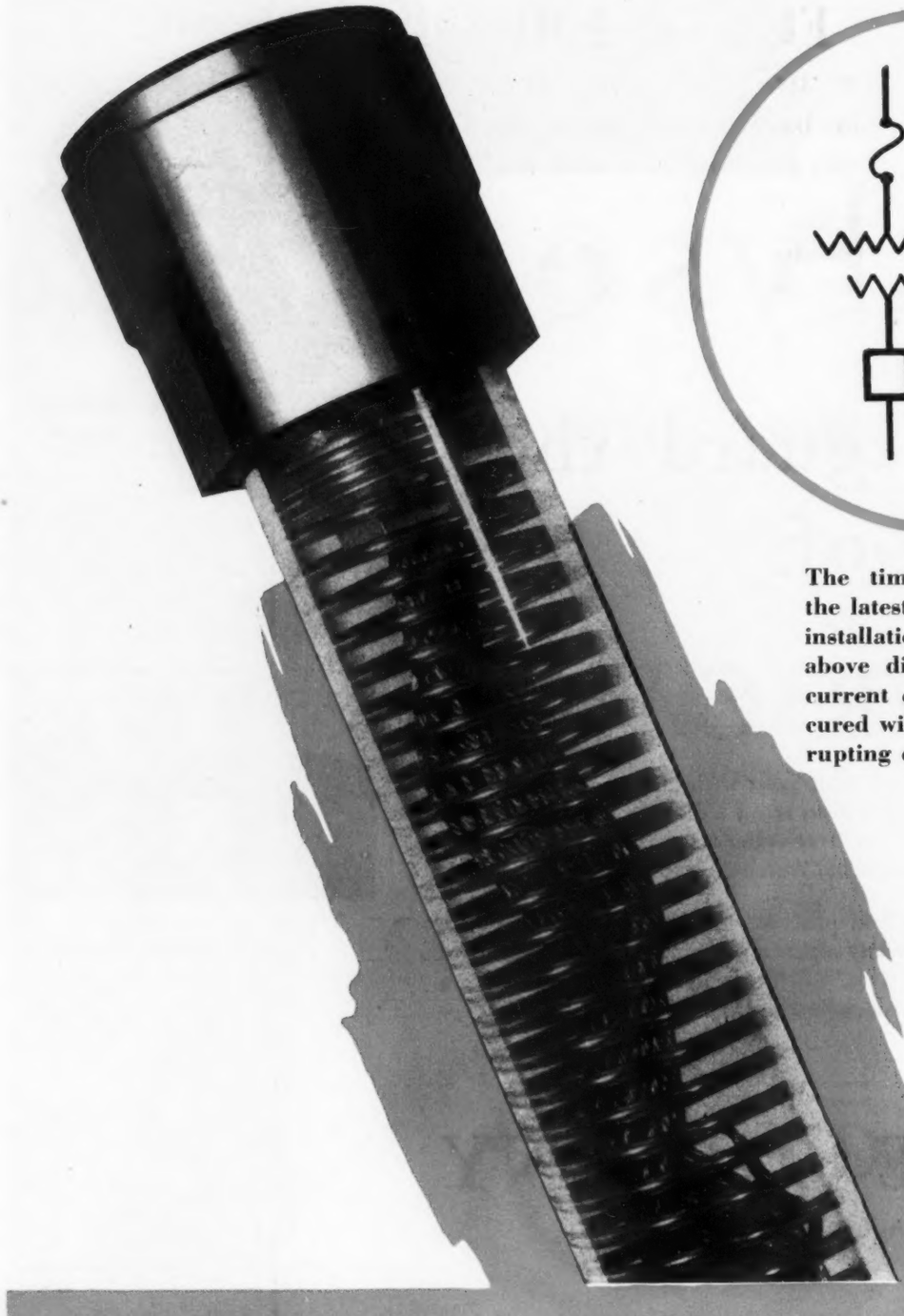
Random test lengths of finished cable must withstand an accelerated life test. Full reels or sample lengths must stand a dielectric loss test. Every reel of cable must withstand an over-voltage test, namely, a full reel commercial test. Beyond these, other convincing tests are made.

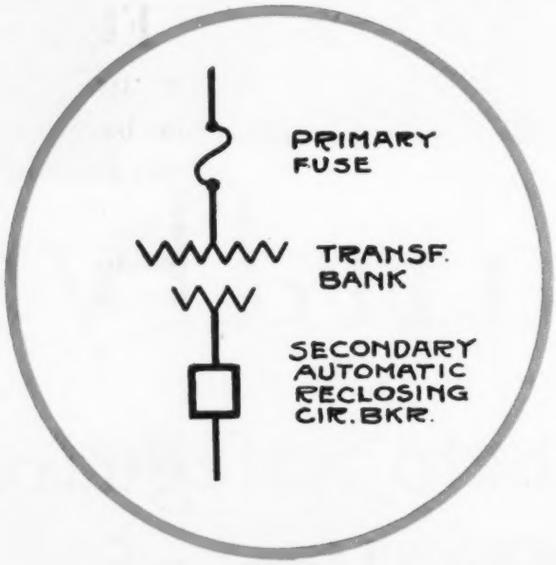
Special equipment and perfected processes of Anaconda design make possible the production of a vastly superior paper insulated lead sheathed power cable. To utility executives, purchasing agents and engineers, we welcome the opportunity to demonstrate our reasons for making so strong a claim.

& CABLE COMPANY

Chicago Office: 20 North Wacker Drive Building
Principal Cities

The Latest S & C all the TIME DELAY



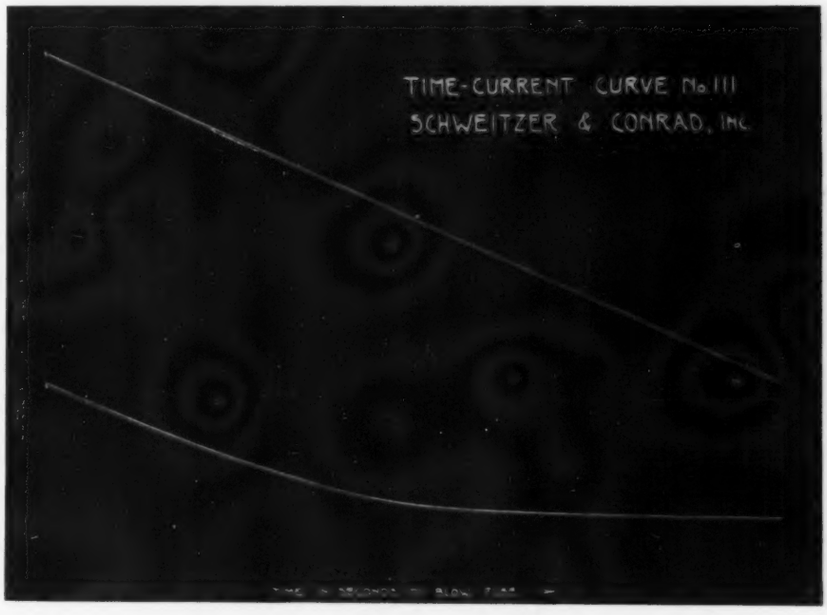


The time-current characteristics of the latest S&C Fuse make it ideal for installations such as shown in the above diagram. Its desirable time-current characteristics have been secured without sacrificing either interrupting capacity or dependability.

FUSE *will give you you need–*

A NEW S&C FUSE ELEMENT has been designed to give ample time delay for selective action, in transformer bank installations, between the secondary automatic reclosing circuit breakers and the primary S&C Fuse.

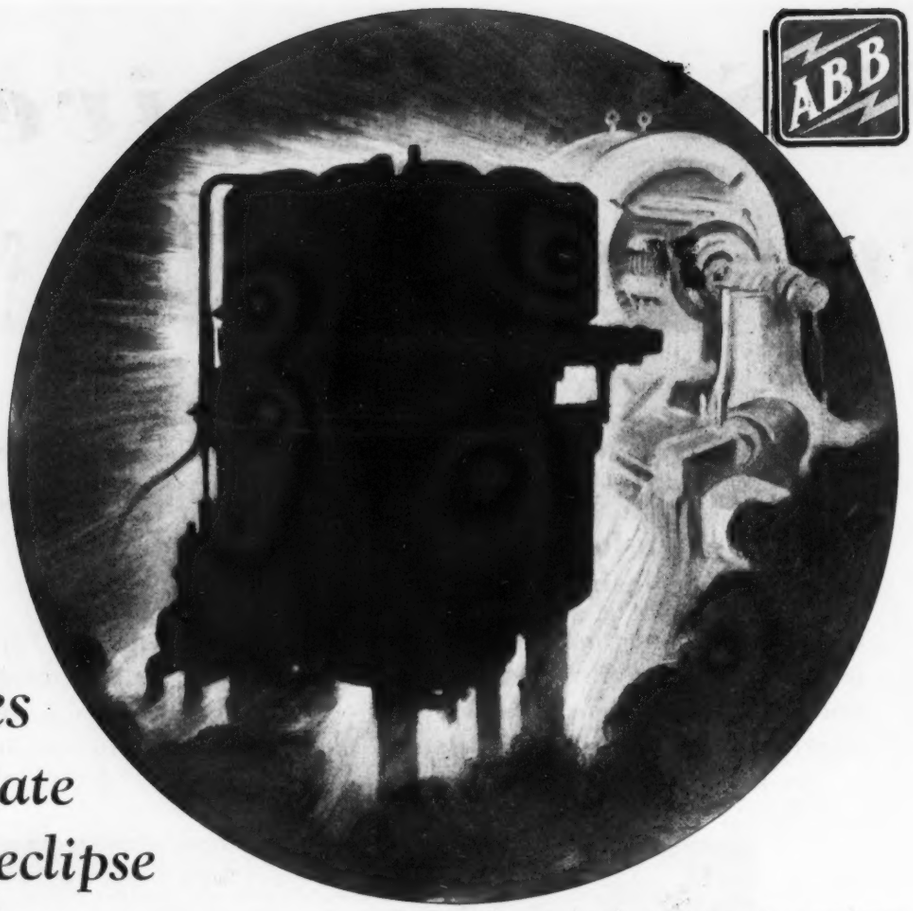
If you have wanted more time delay in fuse operation for certain locations on your system, you will be interested in getting the latest time-current data on the S&C Fuse which has just been made available. Get in touch with our nearest correspondent or write us direct now.



SCHWEITZER S AND C CONRAD, INC.

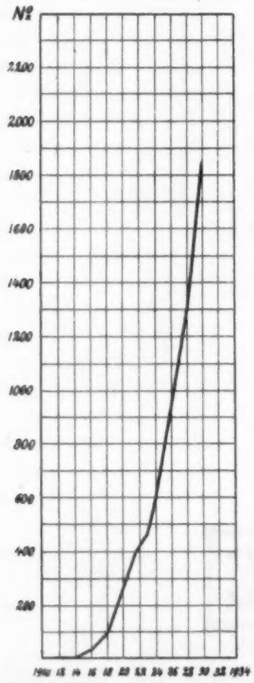
4435 RAVENSWOOD AVENUE CHICAGO, ILLINOIS, U.S.A.

Trade Mark Reg. U.S. Pat. Off.

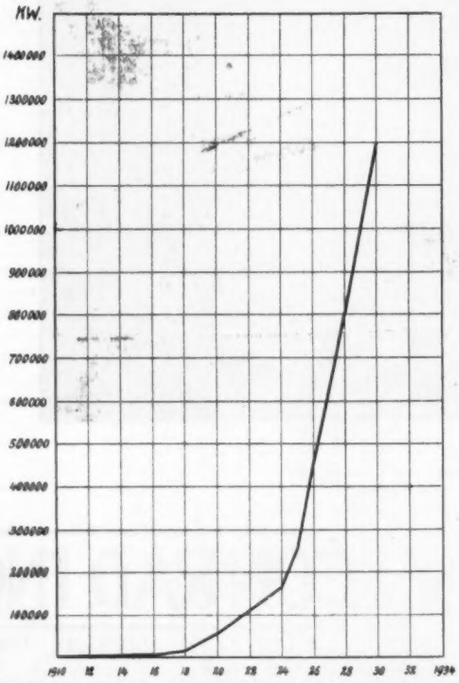


Some figures that substantiate the predicted eclipse

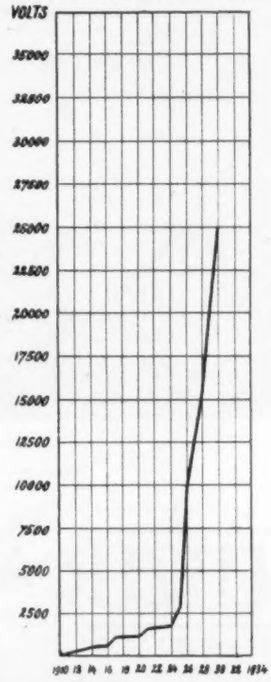
Total number of Brown Boveri power rectifiers delivered from 1910 to 1930.



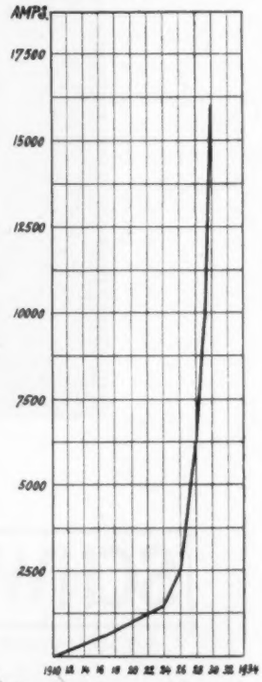
Total output of all the Brown Boveri power rectifier delivered from 1910 to 1930.



Increase in rated voltage of Brown Boveri power rectifiers between 1910 and 1930.



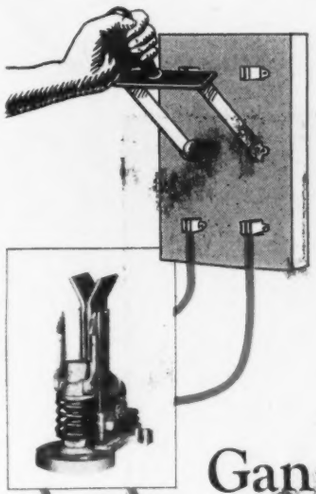
Increase in rated current of Brown Boveri power rectifiers from 1910 to 1930.



AMERICAN BROWN BOVERI CO., INC., CAMDEN, N. J.

AMERICAN BROWN BOVERI

SWITCH TO A STAR



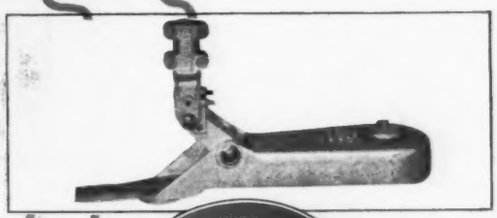
The DELTA-STAR "MA-39" Gang Operated Switch

Medium pressure, large area full floating self-aligning contacts, fully closed when switch is open . . . excluding dust, dirt, ice or soot accumulations.

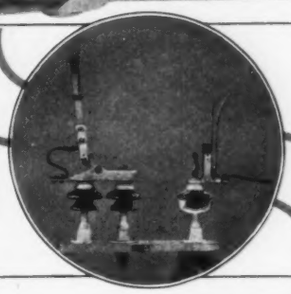
Sufficient *pressure* to wipe the contact clean with each operation without undue wearing away of metal. Sufficient *area* of contact surface for proper dissipation of heat and absolute self-alignment prevents any possibility of point contact only.

These combined features result in a low resistance joint whether the switch is new or old and good contact is assured on all three phases without precision adjustments between individual units.

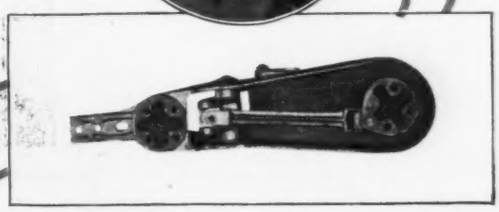
A chain is no stronger than its weakest link, and the same is true of an air break switch. Scientific research and long observation of switches in service has resulted in a design free from weak links. Every part is sturdy, simple and all combine to make a switch which scores as near to 100 per cent perfect as it is humanly possible to make.



Roller bearings at crank journal acting in conjunction with ball bearing, rotating insulator insure ease of operation and freedom from binding or "freezing".



A heavy galvanized malleable iron chassis carries blade and its operating mechanism. When repairs are necessary—complete element may be easily removed without disturbing adjustments.



Even under abnormal surge conditions, insulator or live end of switch will flash to ground—insuring complete protection to operator.

Ask for New Bulletin 39-A

THE KIND OF GANG SWITCH YOU WOULD EXPECT DELTA-STAR TO BUILD

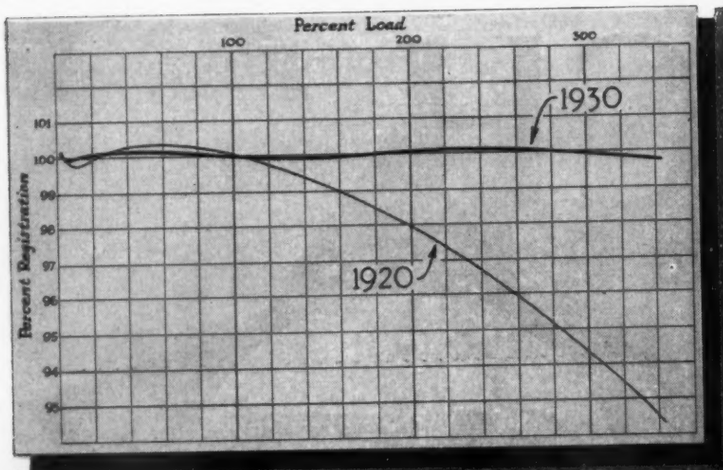
Ask for New Bulletin 39-A

DELTA-STAR ELECTRIC CO.

2400 Block, Fulton St. - - Chicago, Ill.

MAKERS OF

Delta UNIT TYPE EQUIPMENT Star


Percent Load
100
200
300
Percent Registration
101
100
99
98
97
96
95
94
93
1930
1920

KILOWATT HOURS

DUNCAN
for
sustained
accuracy

For the Modern Load

ELECTRIC refrigerators, radios, electric ranges, and a hundred other electrical appliances becoming ever more popular, are building consumer loads and increasing Central Station revenue.

To ensure the full measure of this increased revenue for the central station, meters have been greatly improved as to accuracy under heavy load conditions.

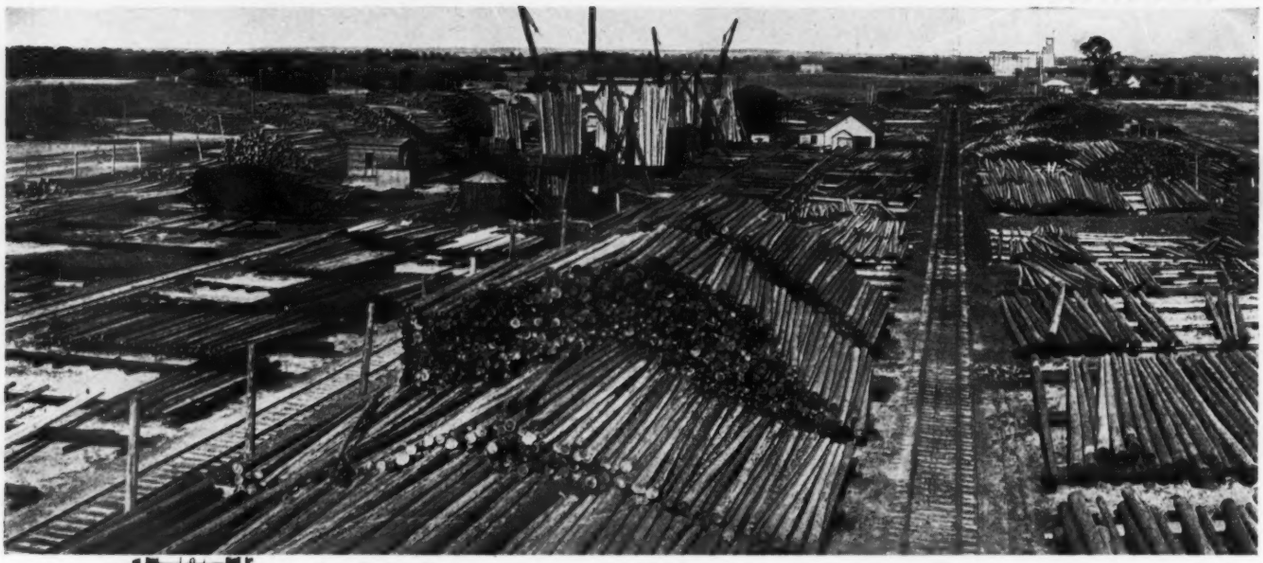
The Duncan Type MD has practically a straight line load curve up to and above 300% load.

Improved design with the same rugged construction and ready accessibility for adjustment, all point to permanent accuracy of enduring character, well suited for measurement of the modern load.

DUNCAN ELECTRIC MANUFACTURING CO.
Lafayette, Indiana

DUNCAN
WatthourMeters

Where ample storage space counts



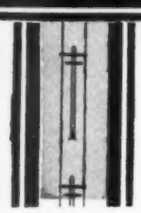
AMPLE storage space is an important factor in the production of good poles. It facilitates the handling of large orders. It assures a well-seasoned product. It provides ample room for the proper stacking of poles—reducing handling damage.

Six of these large, well-equipped Naugle yards, conveniently located and well stocked assure these qualities in Naugle Service—"a service that tells" in the quality of Naugle Poles.

WESTERN and NORTHERN CEDAR
With or without Butt-Treatment.

Complete facilities for framing, shaving, and color staining of poles.

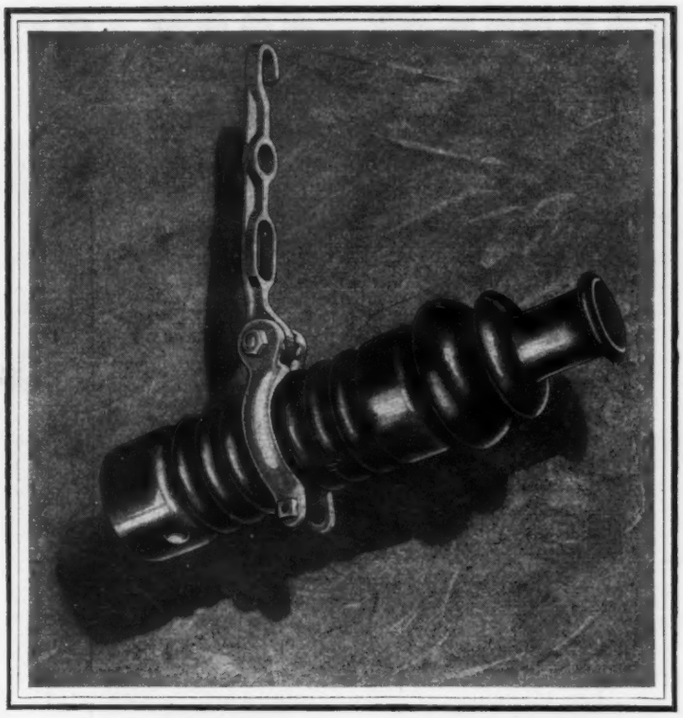
NAUGLE POLES
—FOR NEARLY HALF A CENTURY



NAUGLE POLE & TIE COMPANY
A division of International Forest Products, Inc.
59 East Madison St., Chicago

BRANCHES: New York, Columbus, Kansas City, Spokane, Boston, Madison, Los Angeles.
MAIN YARDS AND BUTT-TREATMENT PLANTS: Minneapolis, Minn.; Pinconning, Mich.; Spokane, Wash.; Sand Point, Idaho; Seattle, Wash.; Arrowhead, B. C.

Canadian **Northern Electric Company** LIMITED *Distributors*



KEARNEY-DOUBLE-DUTY-CUTOUTS

CONE CLEVISES

AFFORD

Performance, Protection, Permanence

PERFORMANCE in actual service—where performance really counts. Kearney Double Duty Cutouts are easily operated and easily serviced. Fuse Cartridges are interchangeable with the disconnect blades. Contacts may be wiped without interrupting service.

PROTECTION to the operator as well as to the line. Kearney Double Duty Cutouts are made of plastic wet process porcelain. Thus the porcelain used in the Double Duty Cutout is equal in mechanical and dielectric strength to the line insulators for it is identical with them both in materials and methods of manufacture.

PERMANENCE is assured because of the use of enduring materials in the manufacture of Double Duty cutouts. The design and the materials from which the cutouts are made were selected only after exhaustive tests; hence long life and faithful service are inevitable.

OTHER KEARNEY PRODUCTS

Screw Type and Expansion Type Anchors, made of certified malleable iron, guaranteed against breakage; Sleeve Twisters with Interchangeable Dies; Fuse Pullers and Disconnect Sticks; Bullet Type Expulsion Porcelain Plug Cutouts; various voltages and amperages of Fuse and Disconnect Switching Equipment.

JAMES R. KEARNEY CORPORATION

4220-40 CLAYTON AVE. · ST. LOUIS, MO.

Factories: **St. Louis, Mo. · Taylorville, Ill. · Toronto, Canada**

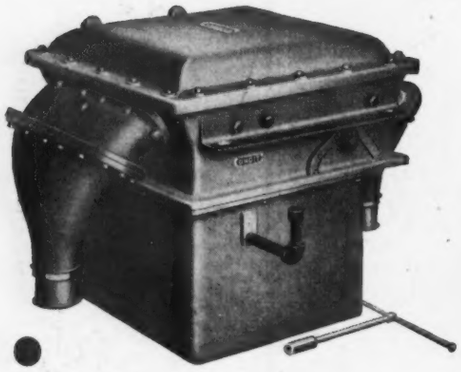
FUSE PULLERS

Kearney Handy Fuse Pullers operate very nearly like the human hand. They are ideal for use in pulling disconnects and fuse switches, as well as for many other wide applications.

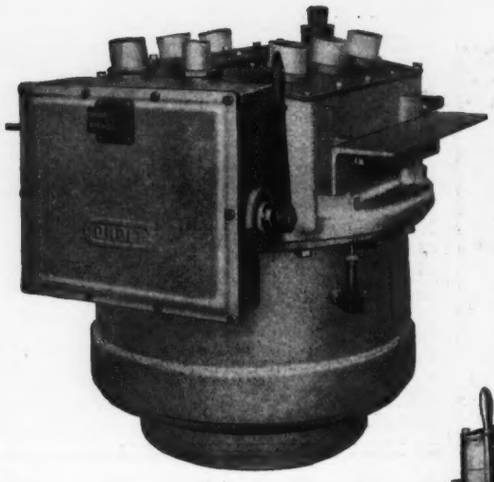
KEARNEY

PRODUCTS WITH A NATIONAL REPUTATION

Outdoor oil circuit and

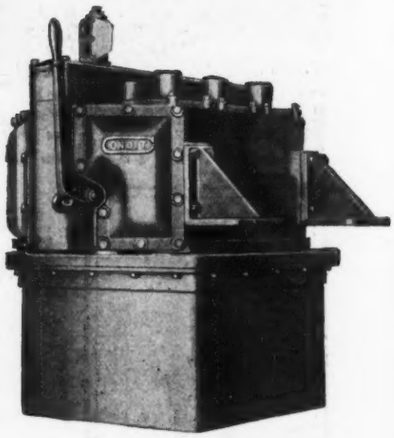


● **M-9** *Manhole Oil Switch.*
800 *Amperes or less.*
7500 *Volts or less.*

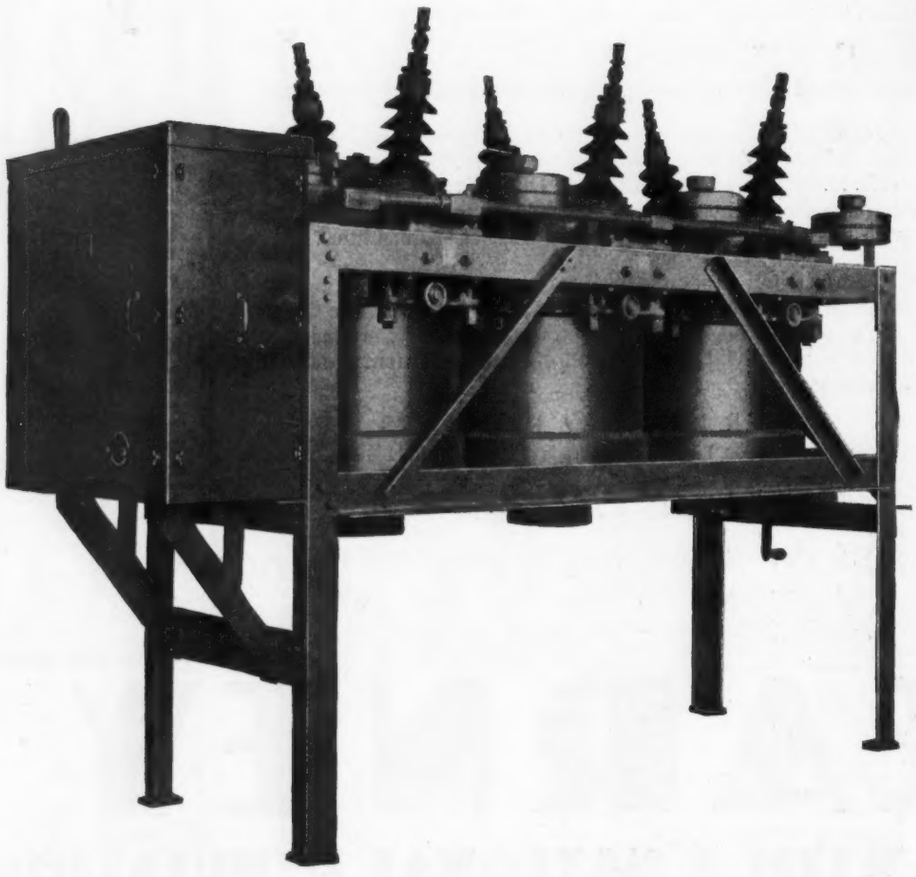


● **M-10**
Manhole Oil Circuit Breaker.
800 *Amperes or less.*
7500 *Volts or less.*
Estimated Interrupting Capacity, 3000 *Amperes at* 7500 *Volts.*

A complete selection for installations demanding proved value, proved performance, and dependable interrupting capacity ratings.

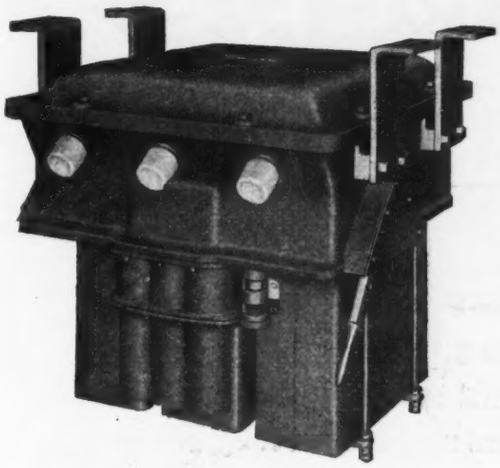


M-210 ●
Manhole Oil Circuit Breaker.
400 *Amperes.*
15,000 *Volts or less.*
Estimated Interrupting Capacity, 2500 *Amperes at* 15,000 *Volts.*



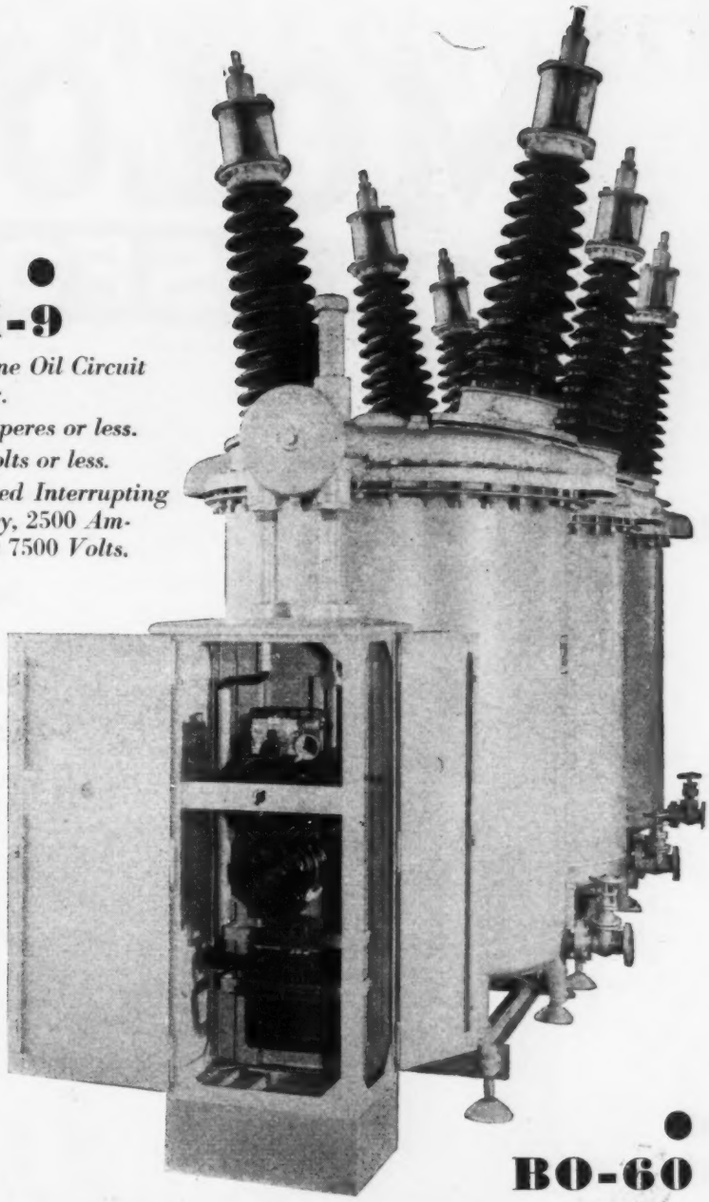
● **FO-40**
A line of High Voltage Oil Circuit Breakers.
Standard capacities.
600—4000 *Amperes.*
23,000—92,000 *Volts.*
Estimated Interrupting Capacities, 1,500,000 *Kv-a or less*

breakers
switches



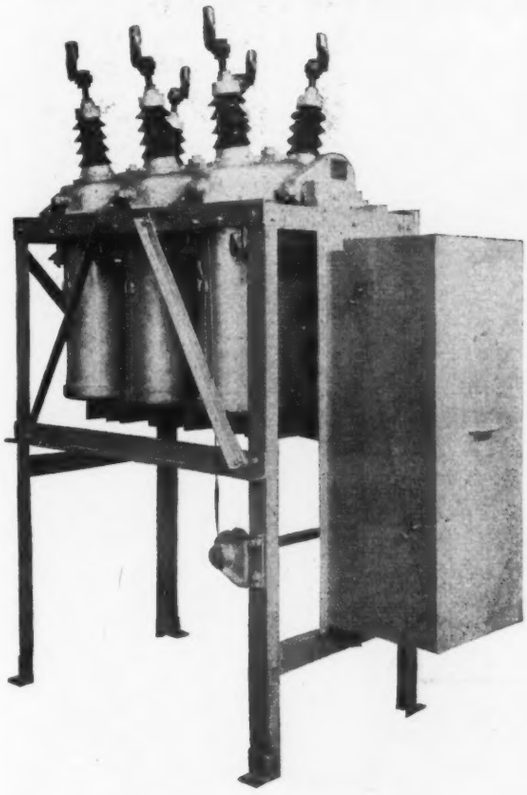
PK-9

Pole Line Oil Circuit Breaker.
800 *Amperes or less.*
7500 *Volts or less.*
Estimated Interrupting Capacity, 2500 *Amperes at* 7500 *Volts.*



BO-60

Super Power Breakers. 400—600 *Amperes.* 115,000 *to* 230,000 *Volts. Estimated Interrupting Capacities,* 2,500,000 *Kv-a or less.*



O-2

Oil Circuit Breaker. 1200 *Amperes or less.* 15,000 *to* 37,000 *Volts. Estimated Interrupting Capacity,* 7000 *Amperes at* 15,000 *Volts.*

"Get in touch with Condit"

Condit Electrical Mfg. Corporation
Boston, Mass., U.S.A.

CONDIT

MOLONEY TRANSFORMERS

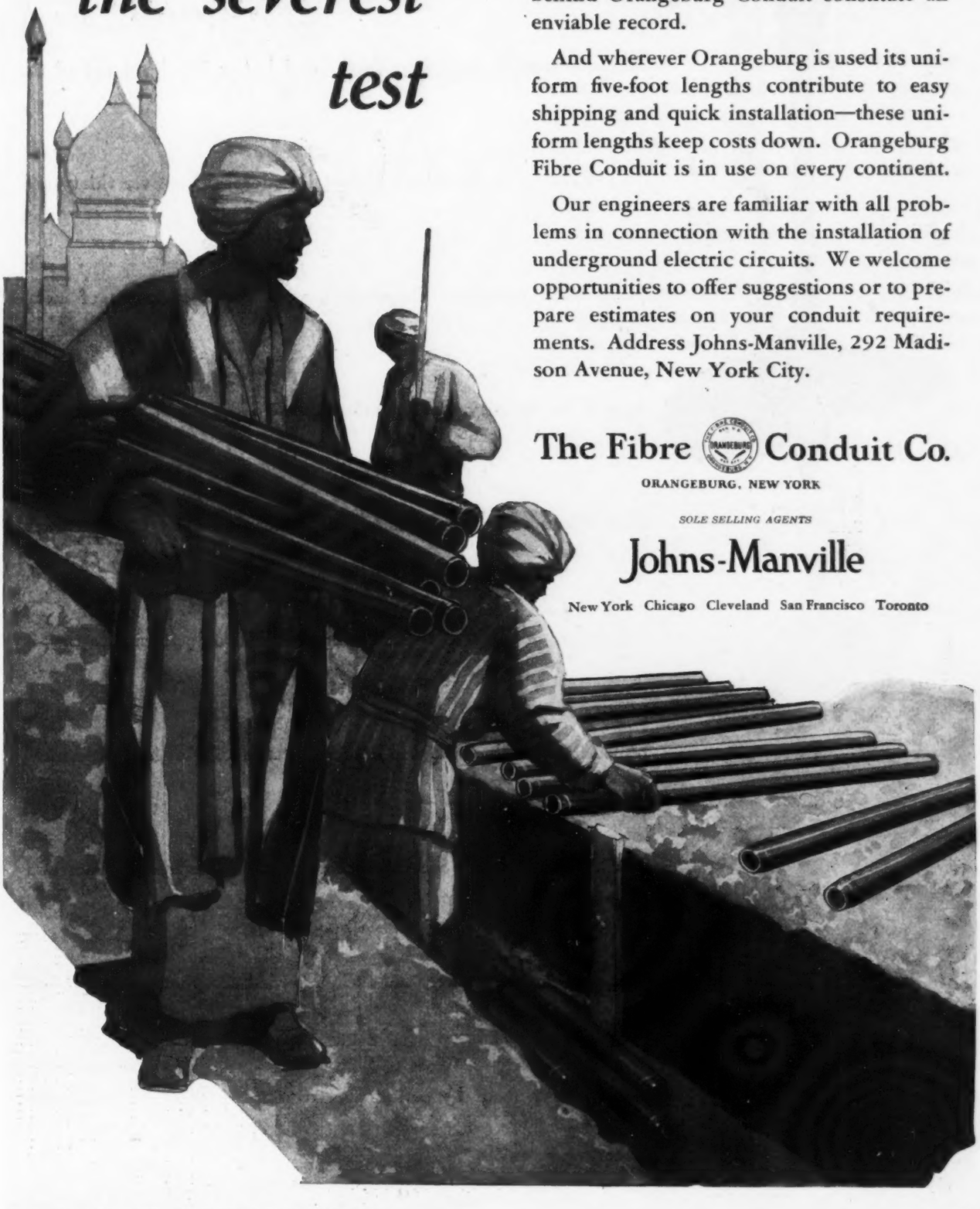
MOLONEY power transformers totaling many hundred thousand KVA. in capacity are performing satisfactory service in all parts of the country.

MOLONEY distribution transformers likewise serve the industry in all sections of the country. A large stock is available at all times.

MOLONEY ELECTRIC CO., St. Louis, Mo.

ORANGEBURG FIBRE CONDUIT

Time is . . the severest test



WHEN age old building looks down on the spread of progress, 37 years may not seem a long time. Yet the fact is that in the growing electrical industry the 37 unbroken years of success which lie behind Orangeburg Conduit constitute an enviable record.

And wherever Orangeburg is used its uniform five-foot lengths contribute to easy shipping and quick installation—these uniform lengths keep costs down. Orangeburg Fibre Conduit is in use on every continent.

Our engineers are familiar with all problems in connection with the installation of underground electric circuits. We welcome opportunities to offer suggestions or to prepare estimates on your conduit requirements. Address Johns-Manville, 292 Madison Avenue, New York City.

The Fibre Conduit Co.

ORANGEBURG, NEW YORK

SOLE SELLING AGENTS

Johns-Manville

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To save you money

Matthews
Scrulix Anchor

Knowing how to do things faster and better has been one of the biggest factors in America's industrial success. For over thirty-one years W. N. Matthews Corporation, with the co-operation of members of the industry, has manufactured and designed specialties, that enable jobs to be done easier and faster. It hasn't been so much a question of price or salesmanship, but one of performance that is responsible for the wide use and acceptance of Matthews Electrical Specialties. Matthews Scrulix Anchors go down easier and faster and have more holding power, and their universal acceptance by users has been brought about by performance over many years under adverse

conditions. Wire bought in coils costs less than wire bought on wooden reels. The Matthews Adjustable Reel for pay-out and take-up makes wire in coils much easier to handle. When taking up wire it is not necessary to pull the wire down on the road and then coil up by hand as the pulling out and coiling up on the reel can be done at the same time. Designed for pulling slack out of guys or cable, hoisting transformers and other equipment, the Matthews Pullift has many uses. It is exceptionally fast; 1000 pounds can be lifted at the rate of sixteen inches per minute—heavier loads proportionately, and weighs only 33 pounds. For complete information send for bulletins.

Matthews
Pullift

Matthews
Adjustable Reel

W. N. MATTHEWS CORPORATION

Engineers and Manufacturers

ST. LOUIS, MO

A new, perfected and important Product from *TERMINAL HEADQUARTERS

SHERMAN Tinned Splicing Sleeves

for Stranded Conductors

(No. 8 B&S to 2,500,000 cm. Cable)

The H. B. Sherman Mfg. Co., outstanding as producers of an economical and high quality line of Terminals, now offers Tinned Splicing Sleeves made to specifications, prepared by an N. E. L. A. Committee. This committee, composed of competent engineers, gathered data from the largest users and after careful study of this information created this product.

Having specialized in Terminal needs of the industry and with ample facilities for successful development it was but natural that this company should be the first to make Tinned Splicing Sleeves. It now becomes one of a series of high quality terminal developments which again emphasizes our desire to serve the industry satisfactorily and economically.

The Sleeves are made only from the highest quality of pure copper, specially manufactured to the exact dimensions specified. Made from new, carefully designed tools, on equipment exactly suited to the manufacture of splicing sleeves. Superior in finish and workmanship—free from burrs.

MARKING—Each Sleeve plainly marked with the number and the name of "Sherman"—This prevents expensive delays and insures easy stock-keeping.

CHARACTERISTICS—Tensile strength ample—so designed that when properly soldered, the wire will break before loosening in the Sleeve.

OVERHEATING—Tests indicate that none of the Sleeves had any tendency to overheat.

Can be used on either round or sector shaped cable. The dead soft anneal allows a very tight mechanical clamping of the Sleeve around the conductor before soldering.

FINISH—All surfaces are smoothly tinned. The solder alloy used is recommended as best practice due to the ease and quickness of soldering the wires in the Sleeves. All outside edges are smoothly rounded.

SERVICE—Orders will be filled promptly from stock, as all sizes are manufactured and stocked in ample quantities to meet ordinary requirements.

SAMPLES—Samples gladly furnished on request. The right is reserved to charge for large sizes, credit granted if samples are returned.

THE H. B. SHERMAN MFG. CO.

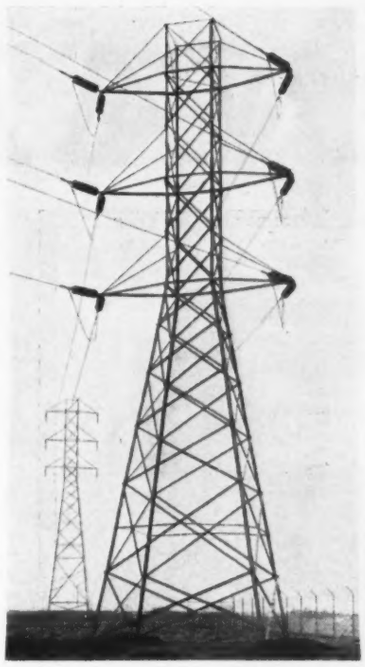
BATTLE CREEK, MICHIGAN

***Headquarters for Terminals**

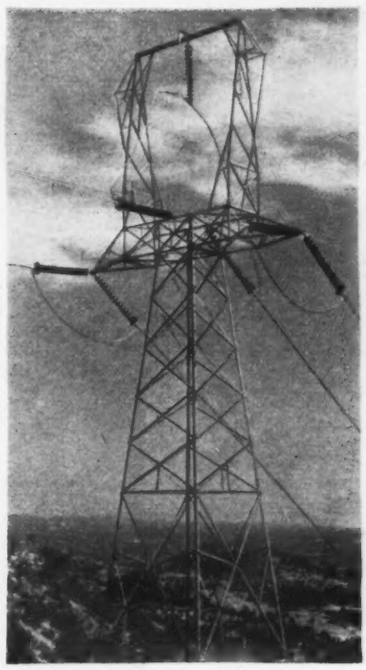
Sherman makes a high quality, complete, and economical line of terminals for the ends of the cables and wires. They are now generally accepted as the proper terminals to use because of their exclusive advantages and economy.

Ask for Descriptive Literature

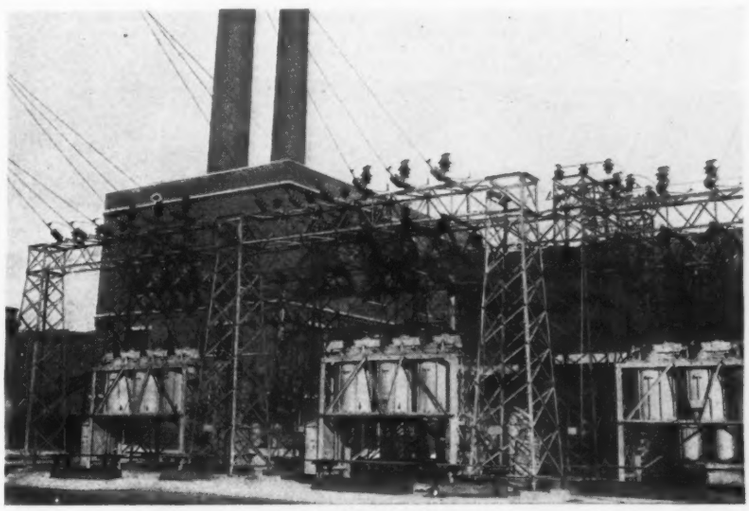
BUILDING FOR THE FUTURE



110 kv. D. E. Tower, San Joaquin Light and Power Company.



220 kv. Tower, Great Western Power Company's Big Bend to Brighton Line.



Power Plant Switch Yard, Utah Power and Light Company.

with STEEL Transmission Structures

Constantly increasing power loads make it necessary that electrical utilities, like other growing and progressive industries, build for the future.

In planning for the transmission of vast amounts of power, modern engineering methods must be employed, the most suitable materials used. Both present and future requirements are best met by steel transmission supporting structures. Steel offers economies and other advantages that can be obtained with no other material.

Extensive experience in the design and fabrication of the many types of steel transmission supporting structures enables Pacific Coast Steel Corporation to offer helpful cooperation in the solution of your problems. The engineering staff of Pacific Coast Steel Corporation will gladly study all conditions and recommend the type of transmission supporting structure that will most economically meet your requirements.

PACIFIC COAST STEEL CORPORATION

Subsidiary of Bethlehem Steel Corporation

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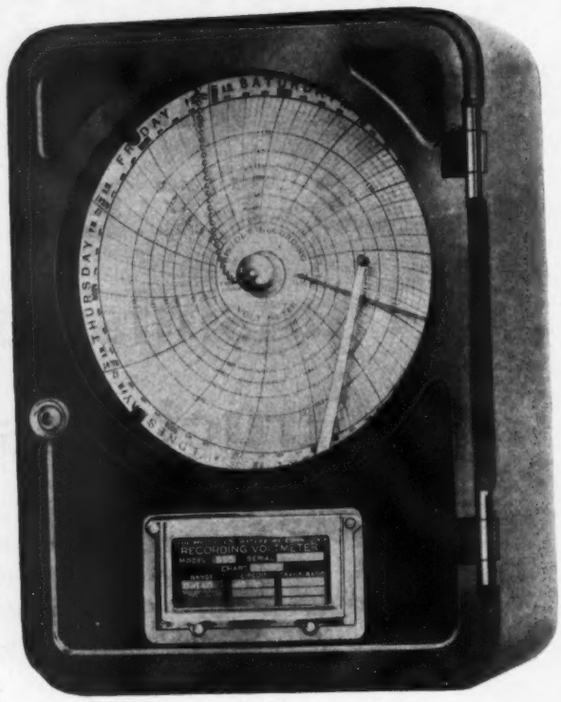
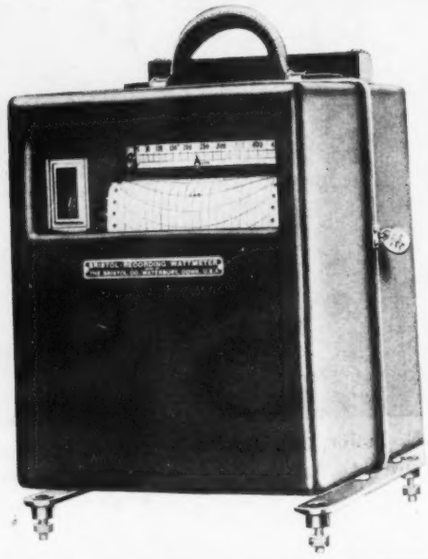
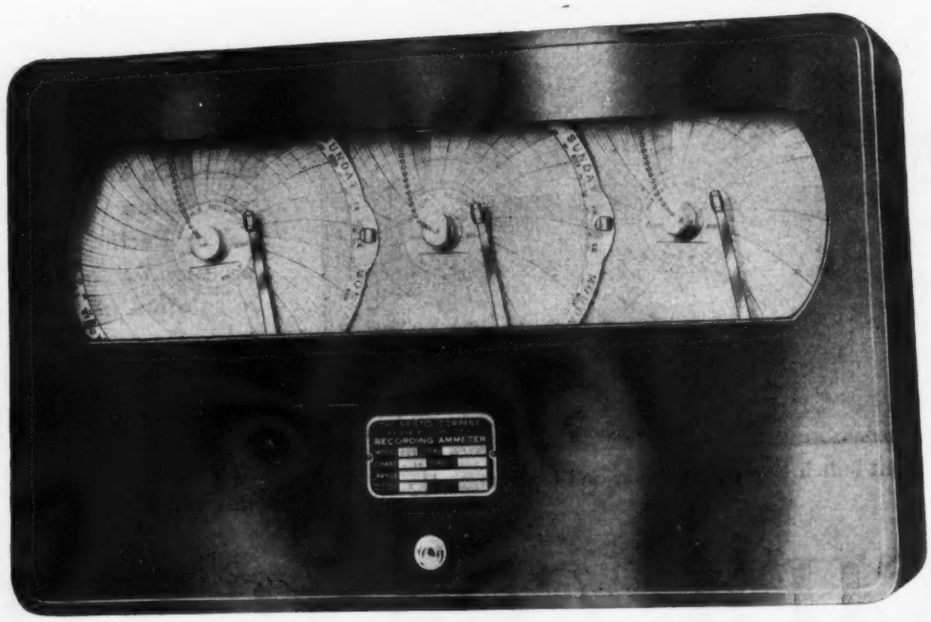
Seattle: 28th Ave. S. W. and W. Andover St. *Portland:* American Bank Bldg. *Honolulu:* Schuman Bldg. *Los Angeles:* Pacific Finance Bldg.

Export Distributor: Bethlehem Steel Export Corporation, 25 Broadway, New York City



ANAL





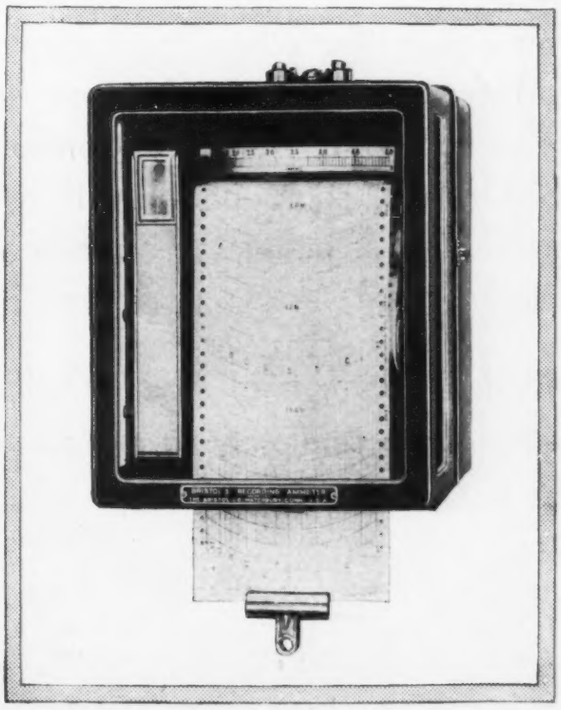
BRISTOL'S RECORD

YSES....

that lead to greater operating economies are made with definite knowledge of conditions.....

Bristol's Recording Voltmeters, Ammeters and Wattmeters furnish invaluable records to public utility engineers and executives for the proper supervision of plant and line.

Accurate and permanent charts are made of all conditions from turbines to feeders; such as output of main units, substation loads, voltage on distribution and incoming feeder lines, power used by auxiliaries, etc. Here you have data, which when analyzed become guideposts to greater operating economies.



Bristol's field engineers will gladly recommend instruments that will enable you to have a continuous survey of conditions.

THE BRISTOL CO.
WATERBURY, CONN.

ING INSTRUMENTS

TIME IS RUTHLESS

IT is a law of nature that all things grow old, wear out, disintegrate. Time has leveled great cities and has caused nations to vanish from the earth.

If man and his works are to survive, it is necessary that we combat the ruthlessness of Time. All that we have must be preserved and made to last.

Electrical cables are not laid easily or cheaply, so they must be prepared for a maximum life. When paper-insulated, lead-sheathed, electrical cable is impregnated with Hercules Commercial Abietic Acid, compounded with hydrocarbon oils of either the naphthene or paraffin base types, maximum life is assured.

Hercules Commercial Abietic Acid is clean and clear, with a relatively small content of oxidized and polymerized products.

A layer of Hercules Commercial Abietic Acid 1¼ inches thick in a six-inch crystallizing dish

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HERCULES POWDER COMPANY
INCORPORATED

975 MARKET STREET, WILMINGTON, DELAWARE

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ETHYL ABIETATE
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STEAM-DISTILLED WOOD TURPENTINE
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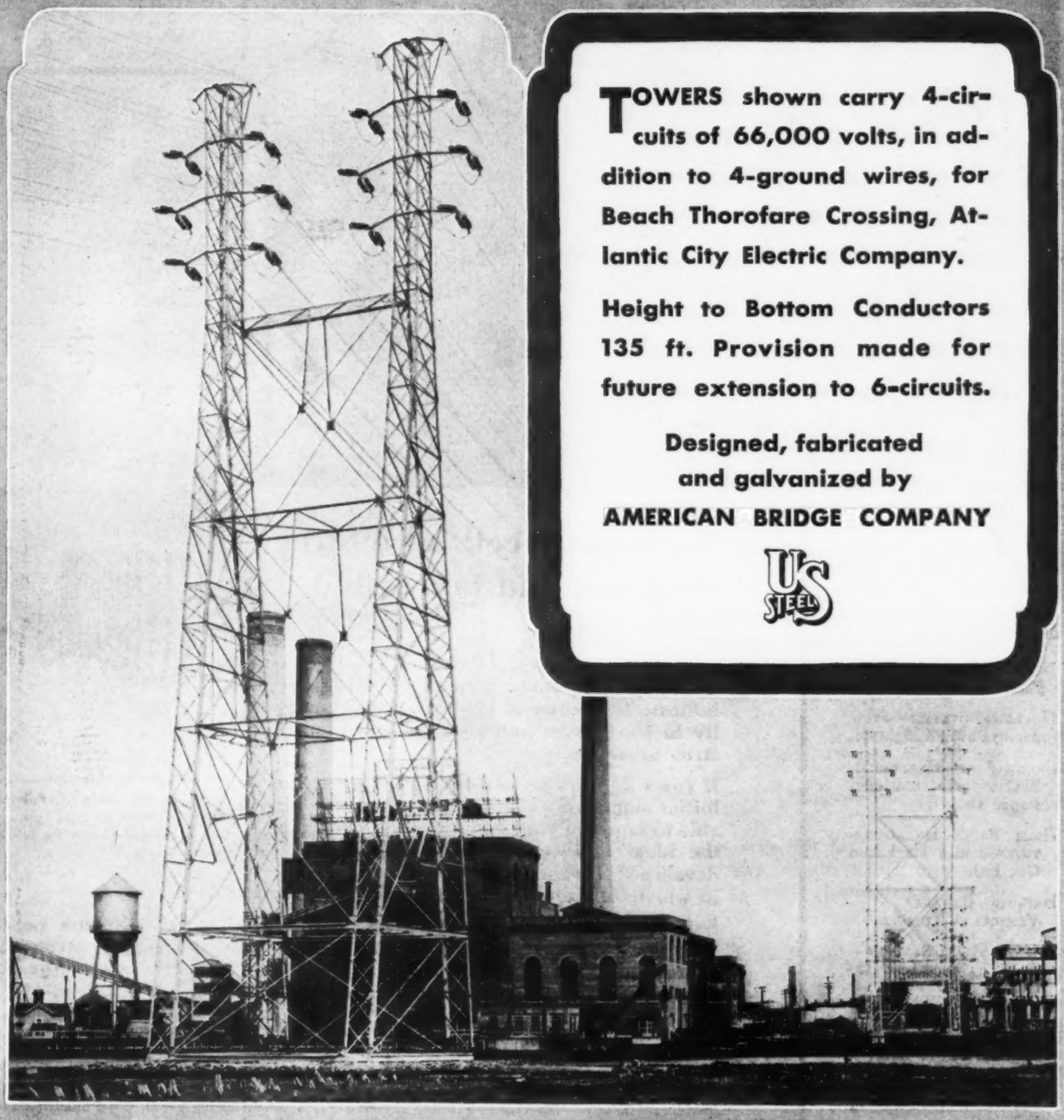
PURIFIED COTTON LINTERS
COMMERCIAL ABIETIC ACID

ABCo TRANSMISSION TOWERS



TOWERS shown carry 4-circuits of 66,000 volts, in addition to 4-ground wires, for Beach Thorofare Crossing, Atlantic City Electric Company.

Height to Bottom Conductors 135 ft. Provision made for future extension to 6-circuits.

Designed, fabricated and galvanized by

AMERICAN BRIDGE COMPANY

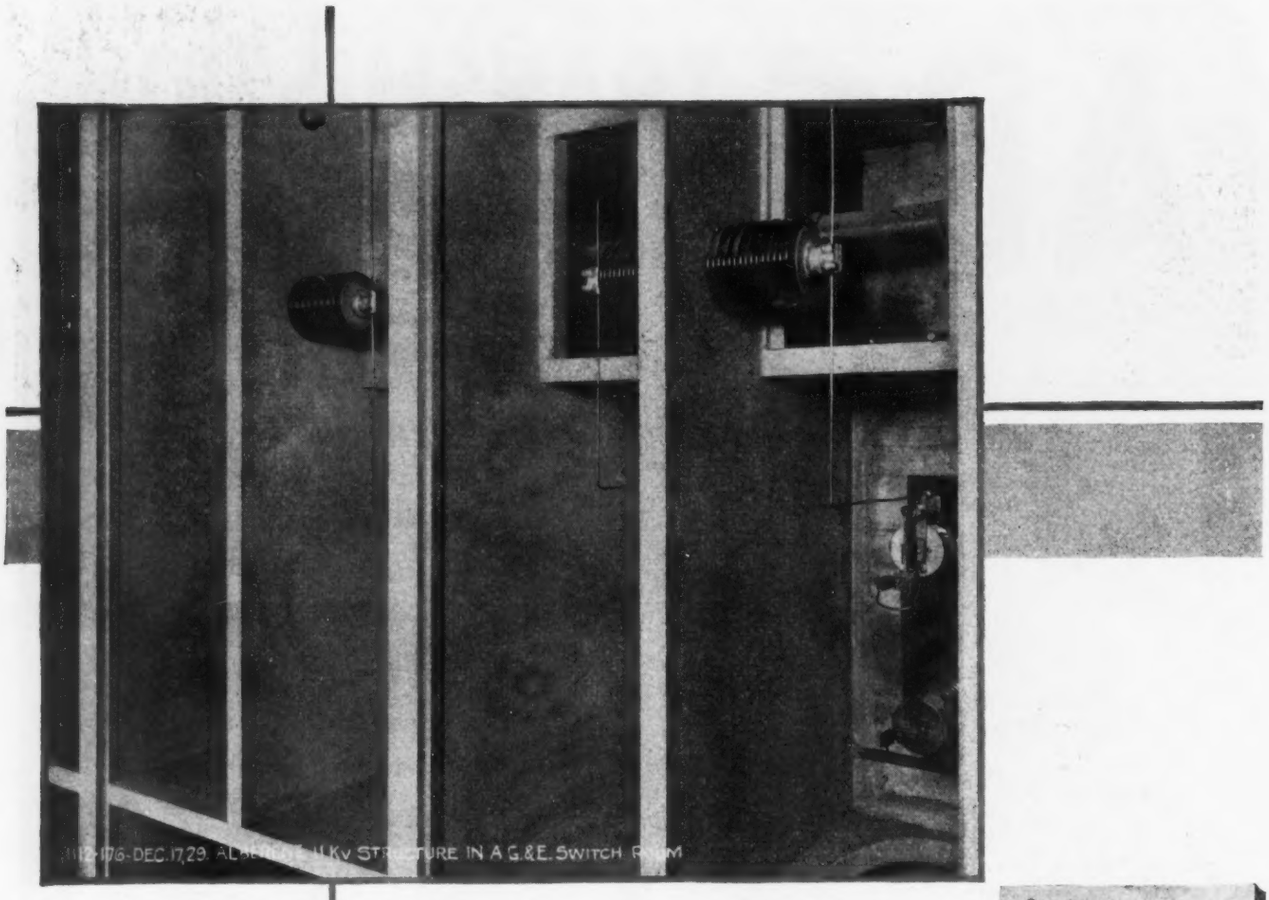
US STEEL

AMERICAN BRIDGE COMPANY

Subsidiary of United States Steel Corporation

General Offices - 71 Broadway, New York City

Tower Department, Frick Building, Pittsburgh, Pa.



Partial list of prominent stations in which Alberene Cell Structures are installed:

DEEP WATER STATION—Penns Grove, N. J.

HOLLAND STATION—New Jersey Power & Light Co.

GRAND FALLS HYDRO-STATION—International Paper Co.

HIGH FALLS HYDRO-STATION—James MacLaren Co., Ltd.

DETROIT—CANADA VEHICULAR TUNNEL

MARION STEAM STATION—Indiana General Service Co.

FIFTEEN MILES FALLS HYDRO-STATION—New England Power Assn.

D. L. & W. R. R. Co. ELECTRIFICATION — 11 Sub-Stations

WATERVILLE HYDRO-STATION—Carolina Power & Light Co.

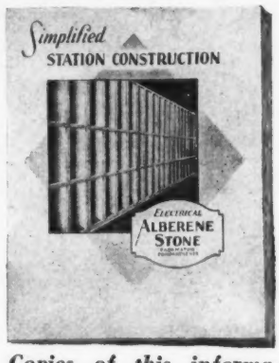
HARRIS AV. SUB-STATION—Narragansett Electric Co.

Have your cell structures designed and fabricated by experts

The notable stations named on this page indicate the scope of this company's activity in the design and construction of cell structures.

If you will allow us to work with you in the initial stages of your planning, we will be able to apply to your cell structure problem the ideas and economies that have been developed in the diversified installations in which Alberene Stone has been used successfully.

Safety, economy and compactness are assured when Alberene Cells, with steel supporting members are used. High in dielectric strength, non-staining, moisture, fire and flame proof, Alberene is structurally strong and easily worked as well.



Copies of this informative brochure sent gladly on request; contains tests, details, etc.

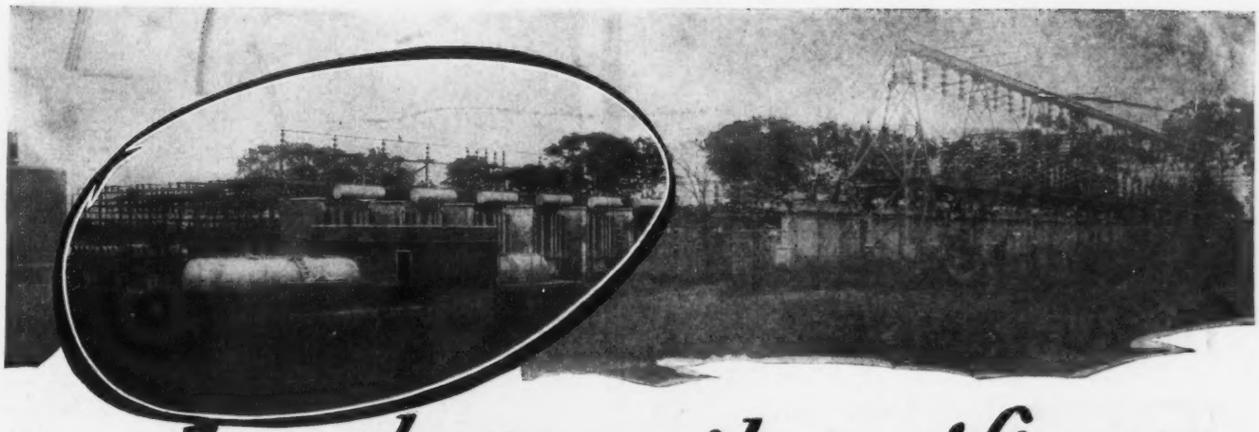
Inquiries will receive prompt attention from a specialist in cell design and construction.

Alberene Stone Company, 153 West 23rd Street, New York City

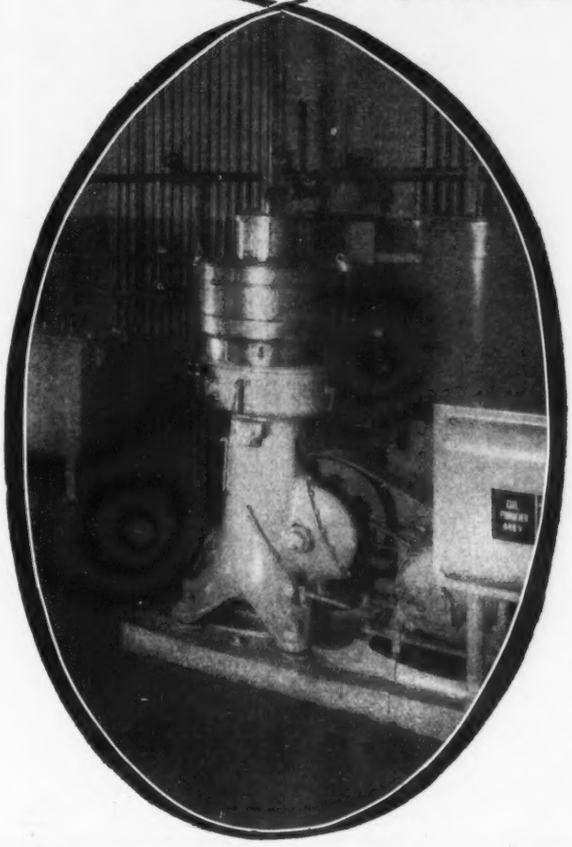
Branches—Chicago—Cleveland—Pittsburgh—Newark, N. J.—Washington, D. C.—Philadelphia—Boston—Rochester—Richmond

Quarries and Mills at Schuyler, Virginia

ALBERENE STONE CELL STRUCTURES



Insulating oil purification —a construction problem



COMPLETION of the oil purification plant ahead of the rest of the sub- or switching-station is a new short cut to economy in getting transformers and circuit breakers into operation.

Pipe connecting the transformers and breakers to a central oil purification plant equipped with large capacity De Laval Insulating Oil Purifiers has proved to be by far the most economical means of maintaining the di-electric strength of oil at the large stations which are now being built by many systems.

Such a purification plant performs its greatest service, and may often entirely pay for itself, during the period in which the substation is under construction and oil-holding apparatus is being filled. For this reason, it is becoming standard practice to build and equip the oil purification plant before the transformers and circuit breakers are erected, so that oil can be readily unloaded from the cars, dehydrated and pumped into the units.

De Laval engineers will be glad to co-operate with you in designing, constructing and operating your substation oil purification plants. Write for Bulletin 107-W.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 600 Jackson Blvd., Chicago
DE LAVAL PACIFIC COMPANY, 61 Beale Street, San Francisco
THE DE LAVAL COMPANY, Ltd., Peterborough and Winnipeg, Canada
ALFA-LAVAL CO., Ltd., 34 Grosvenor Road, London, S. W. 1.

DE LAVAL OIL PURIFIER

TRANSMISSION LINE INSURANCE

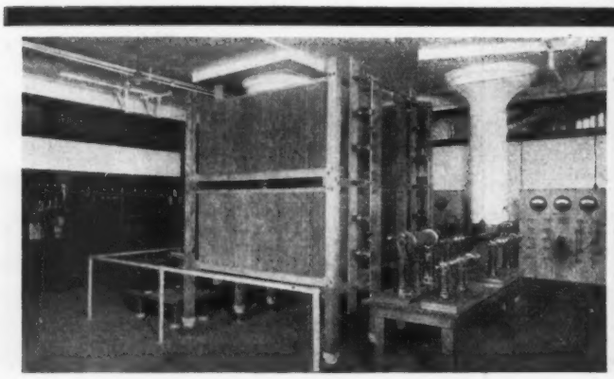
THE best insurance policy you can buy would include Franklin porcelain insulators which are manufactured by modern methods in a modern plant with every facility for thorough testing — proved good by years of service.

Keystone Insulator Pins—the original pin designed twenty years ago and still good. Over two million in use and not a single failure reported.

Crystal Valve Lightning Arresters—the true valve type lightning arrester for voltages of from 350 to 25,000. Thousands have been in service for over five years with a most unusual record of highly satisfactory performance.

Specify this time tried and proven equipment. It is the best insurance policy you can buy against line failures.

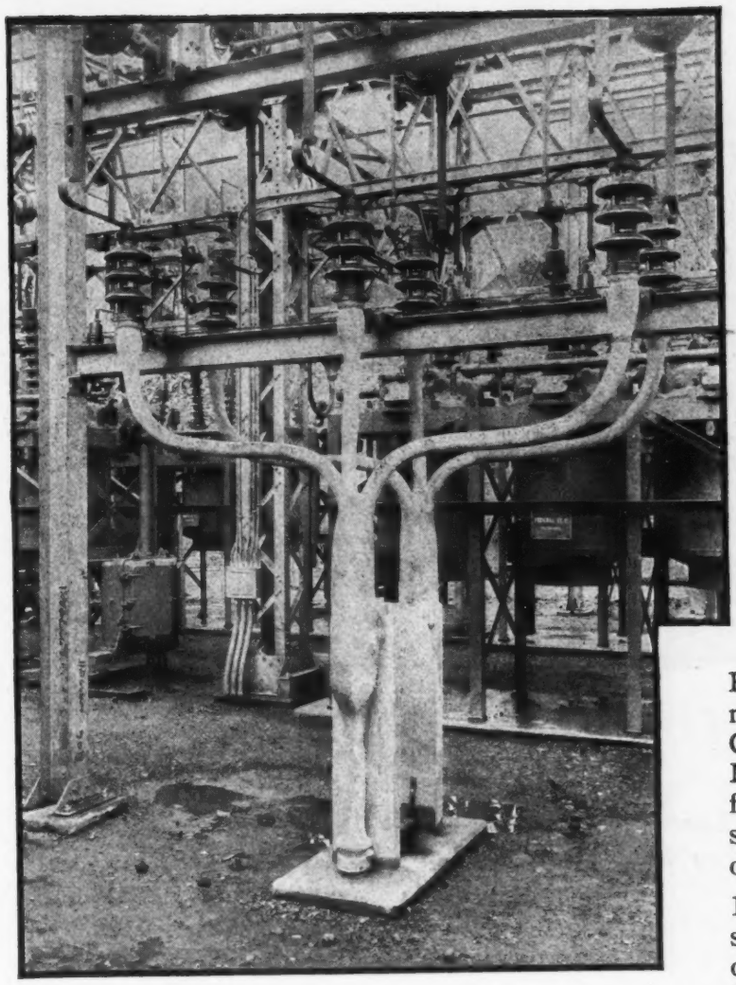
Below—A Portion of Our Well Equipped Laboratory Showing Lightning Generator used for Research and Development Work.



ELECTRIC SERVICE SUPPLIES CO. Manufacturer

RAILWAY, POWER AND INDUSTRIAL ELECTRICAL MATERIAL

Home office and plant at 17th and Cambria Sts., PHILADELPHIA; District offices at 111 N. Canal St., CHICAGO; 50 Church St., NEW YORK; Bessemer Bldg., Pittsburgh; 88 Broad St., Boston; General Motors Bldg., Detroit; 316 N. Washington Ave., Scranton; Canadian Agents, Lyman Tube and Supply Company, Ltd., Montreal, Toronto, Vancouver, Winnipeg.



NO COSTLY INTERRUPTIONS WITH STANDARD MULTI-UNIT TERMINALS

Recognizing the limitations of a single terminal for multi-conductor cable General Cable engineers developed the Standard Multi-Unit Terminal to obtain the highest factor of safety and to eliminate costly service interruptions. These terminals have outstanding advantages some of which are:

1—Ability to place the terminals to suit the spacing of the high voltage conductors in outdoor service poles, and ease of connecting them in a direct line.

2—In case of damage by lightning or mechanical injury to an insulator on one phase, repairs can be made quickly and service restored promptly.

3—Greater spacing between live parts over any possible single piece unit. This is especially valuable in times of heavy rain, sleet, or snow storms.

Standard Multi-Unit Terminals consist of two or more single-conductor terminals fitted with single-conductor cable stubs, usually from 7 to 10 feet long. These have cross-sections of copper and insulation suitable for the terminal's voltage requirements.

When terminals are thus specified with stubs attached, skilled workmen make all cable-terminal connections at the factory under the most careful supervision and inspection.

Send for the Standard Accessory catalogs with complete illustrated information.

GENERAL CABLE CORPORATION

EXECUTIVE OFFICES: 420 LEXINGTON AVENUE, NEW YORK • OFFICES IN PRINCIPAL CITIES

Builders of Transformers for every laboratory and industrial application

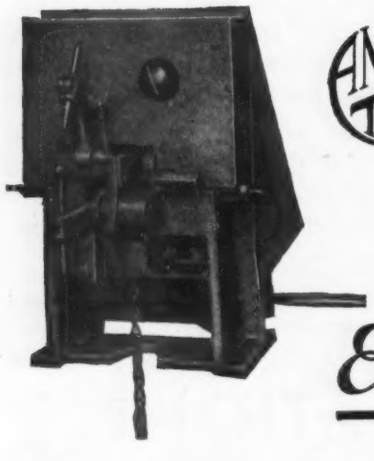
Speed in Production— with the delicate touch of the Craftsman—

THE Amerweld Electric Spot Welding Machine was designed by American Transformer Company engineers for fusing small metal parts, such as the elements in radio tubes and electric light bulbs, in the manufacture of jewelry, dental supplies, novelties, and for small spot welding of all kinds.

It is simple, quick, reliable, safe, and economical of current—hence inexpensive. Equipped with a Ward Leonard Vitrohm rheostat and adjustable within a useful range, both for intensity of heat and the period of application, Amerweld fills a long felt need. As many welds as required can be made with no loss of time, giving maximum productivity and minimum waste of materials. A battery of fifty Amerwelds can be accommodated on a bench one hundred feet long and six inches deep, reclaiming valuable floor space for other operations.

The machine can be supplied for operations on circuits of any frequency, and voltages up to 550 volts. Standard units are carried in stock for 220 and 110 volts—60 cycles.

For further information write for Bulletin 1125.



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Chicago, Ill.—Westburg Engineering Co., 53 W. Jackson Blvd.
Knoxville, Tenn.—Arthur L. Pollard
Minneapolis, Minn.—Elliott Equipment Co., 708 Sixth Avenue, South
Montreal, Canada—W. O. Taylor & Co., Ltd., 415 Canada Cement Bldg.
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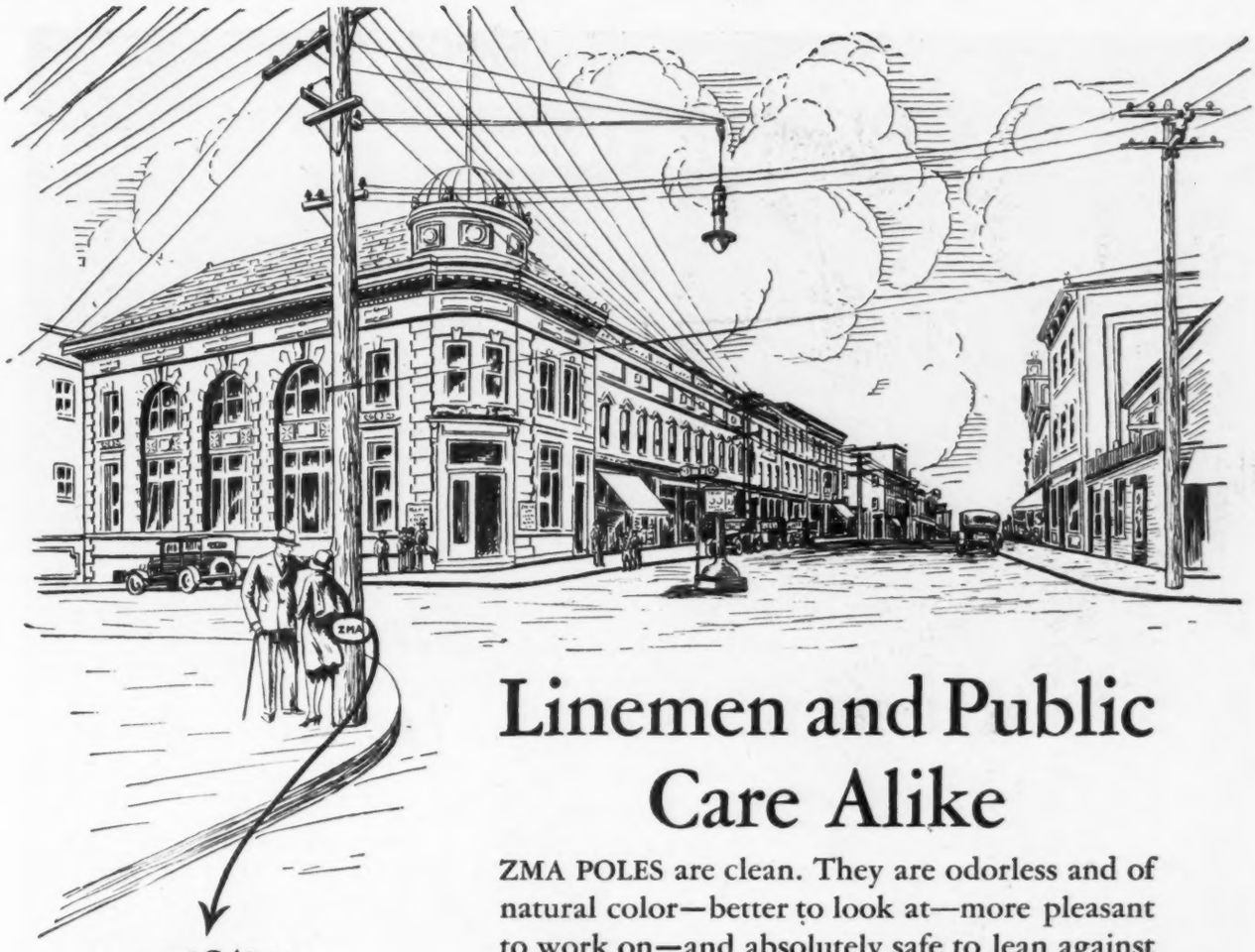
San Francisco, Calif.—James H. Southard, 682 Mission Street
St. Louis, Mo.—J. W. Jones, 432 Pennant Building

AMERWELD *Electric* SPOTWELDER

AMERICAN TRANSFORMER COMPANY 178 EMMET STREET NEWARK, N. J.



STOP DECAY WITH ZMA

ZMA Distributors:

EPPINGER & RUSSELL CO.
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GULF STATES CREOSOTING CO
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Linemen and Public Care Alike

ZMA POLES are clean. They are odorless and of natural color—better to look at—more pleasant to work on—and absolutely safe to lean against without damage to the clothing or the hands.

First consider the economy of the ZMA pressure treatment. There is no leaching or bleeding. The initial treatment is permanent—once protected, always protected.

Then consider the decrease in labor turnover. A lineman will hesitate a long while before quitting a job where poles are clean-treated the ZMA way.

The ZMA treatment answers your wish for long pole-life and community approval. Investigate now. Get all the facts before you. And remember—they're clean—clean and lasting.

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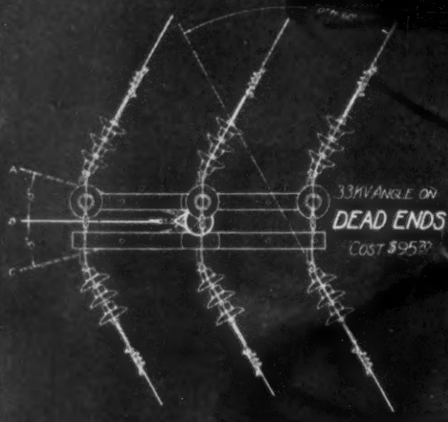
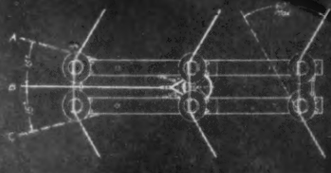
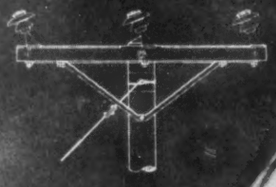
CURTIN-HOWE CORPORATION, Ltd., McGill Bldg., Montreal, Can.
AMERICAN SMELTING & REFINING CO., Gen'l Agents, Mexico City

St. Louis Malleable Angle Pins Built to Withstand Unusual Side Strain

PATENT 1,744,674







33 M.V. ANGLE ON
ANGLE PINS
COST $38.00

TABLE FOR LIMITING ANGLES AND WIRE SIZES

Max. Size Wire M.M.D. Copper or Equivalent	Angles in Line	
	Single Arm	Double Arm
6	45°	60°
4	30°	60°
2	20°	40°
0	12°	24°
00	10°	20°
000	8°	16°
0000	7°	14°

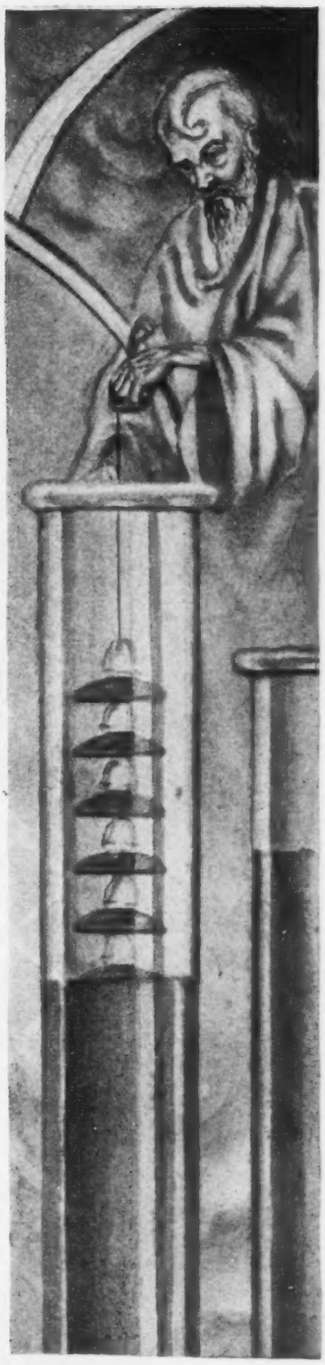
IN designing our Angle Pin a double factor of safety was secured in the facts...that it is built unusually heavy to withstand side strain...and it is designed to keep side strain of the average corner directed to a point in the base, approximately the location of the mounting bolt.

On Angles up to 60 degrees, St. Louis Malleable Angle Pins provide a remarkable saving in both labor and material costs.

ST. LOUIS MALLEABLE CASTING CO.
(ELECTRICAL DIVISION)
7700 North Broadway St. Louis, Mo.

ST. LOUIS MALLEABLE
POLE LINE SPECIALTIES

The TRYING TEST *of* TIME



OBVIOUSLY, the real test of a high-tension insulator is the *Test of Time* . . . on the line. It firmly establishes the ability of the porcelain to cope with the attacks of the elements . . . lightning . . . the power arc. It is *Time* that weeds out the weak . . . glorifies strength.

It is to this test that THOMAS INSULATORS owe their continued and unparalleled success. It is this test that so thoroughly convinces even the most skeptical of the absolute dependability of Thomas Porcelain, of the resourcefulness of Thomas Engineering and of Thomas productive watchfulness and skill.

Thomas Insulator installations, still functioning after a quarter century of hard and continuous service, are common. Some date back to the very inception of electric power transmission.

The Thomas line includes: Pin Types, Break Strains, Guy Strains, Spools, Pin Strains Hewlett, Clevis Type and Ball-Socket Suspension Units, Wall, Roof, Floor and Apparatus Insulators, all kinds of accessory hardware, etc. Thomas Engineers will gladly cooperate in solving any perplexing Insulation problems.

THE R. THOMAS and SONS CO.

Manufacturers of high and low tension porcelain Insulators and Transmission Line Hardware.

ESTABLISHED IN 1873
INCORPORATED IN 1892

LISBON, OHIO
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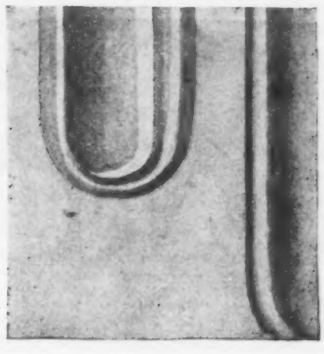
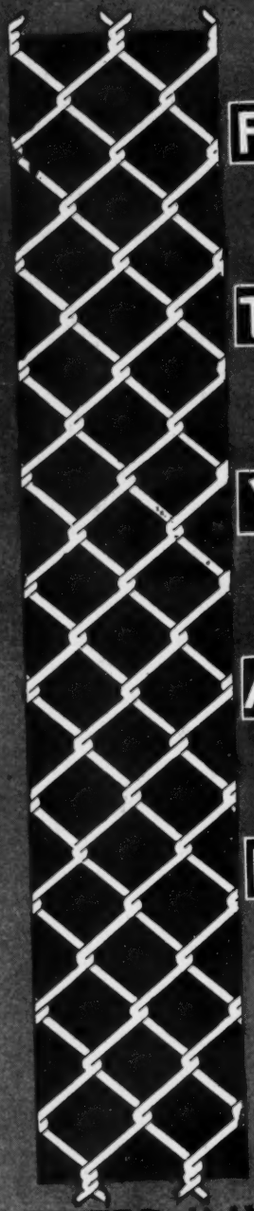


ANCHOR FENCES

GIVE YOU



FIRE PREVENTION

THEFT STOPPAGE

YARD STORAGE

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PERSONNEL CONTROL

WHAT BETTER INVESTMENT COULD YOU MAKE?

ANCHOR POST FENCE COMPANY

Eastern Ave. and Kane St., Baltimore, Md.

Sales Offices in all principal cities

ANCHOR FENCES

Glass is best for medium voltage lines

Has great dielectric strength

This is an accepted fact determined both by scientific experimentation and from actual experience.

Does not age

An analysis of glass insulators after 40 years in service failed to show any deterioration.

Is non-porous

Providing both an extremely hard glazed surface and insulator body absolutely impervious to moisture and the resultant variable dielectric strength.

Is transparent

Providing an easy and certain method of inspection. Internal defects or flaws are easily detected.

Is always uniform

produced by standardized processes and formulae under absolute control—gives it the same mechanical and dielectric quality at all times.

And costs less

both in first cost and lasting quality.

Both by reason of its natural qualities plus those which can be imparted to it by proper manufacturing methods, Glass has fully met all the requirements demanded of an insulator, operating up to 33,000 volts.

The natural qualities of glass for insulation are easily understood—its great dielectric strength—its freedom from aging or deterioration—its non-porous nature—transparency and uniformity.

Through extensive research and 50 years' experience in making glass insulators Hemingray has developed practical insulator designs as well as their own process of annealing and manufacture that assures maximum service from these natural qualities.

A complete stock for emergency shipments on hand. Send for catalog.

HEMINGRAY GLASS COMPANY

Offices and Factories

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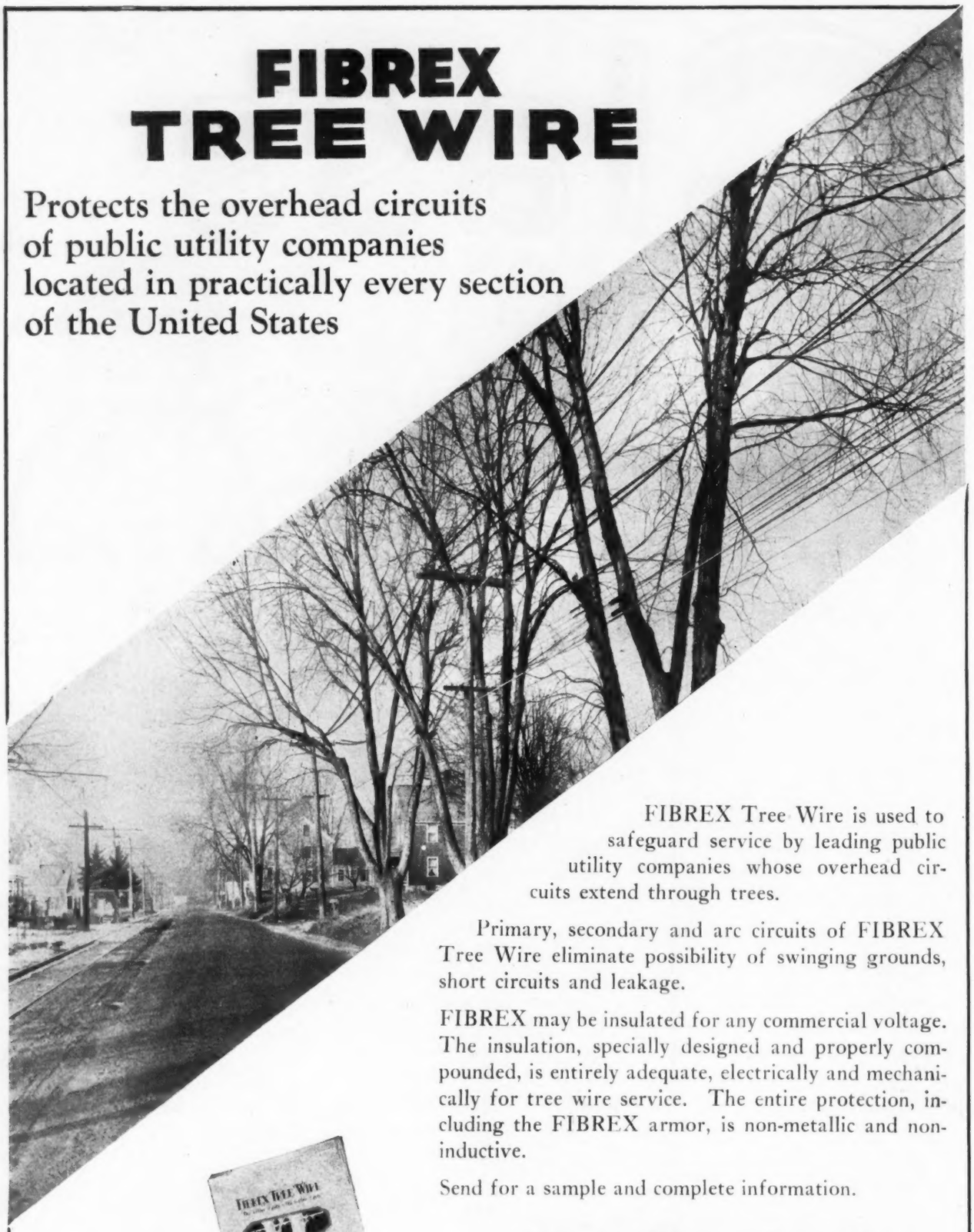
HEMINGRAY

FIBREX TREE WIRE

Protects the overhead circuits of public utility companies located in practically every section of the United States



FIBREX Tree Wire is used to safeguard service by leading public utility companies whose overhead circuits extend through trees.

Primary, secondary and arc circuits of FIBREX Tree Wire eliminate possibility of swinging grounds, short circuits and leakage.

FIBREX may be insulated for any commercial voltage. The insulation, specially designed and properly compounded, is entirely adequate, electrically and mechanically for tree wire service. The entire protection, including the FIBREX armor, is non-metallic and non-inductive.

Send for a sample and complete information.

A copy of our new Booklet, Fibrex Tree Wire, will be sent upon request.

SIMPLEX WIRE & CABLE Co

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PHILADELPHIA, 1227 Fidelity-Philadelphia Trust Building
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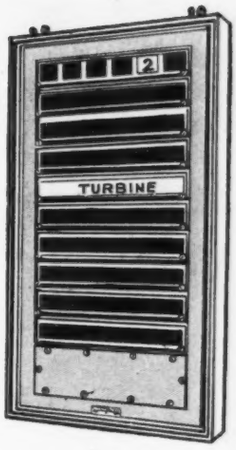
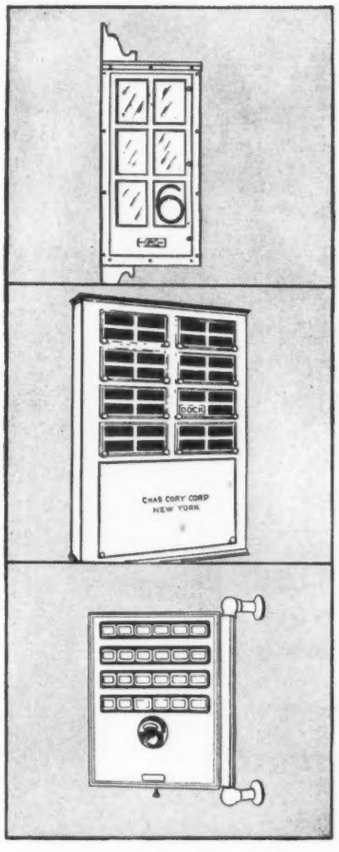
Set Your Requirements



CORY BUILDS AN ANNUNCIATOR TO MEET THEM



PRACTICALLY every operating requirement is met by a standard type Cory Industrial or Central Station Annunciator.

Should you need a special type, Cory engineers possess the skill, equipment and experience to design and build exactly to your specifications.

And all Cory Annunciators benefit by the adherence to strict standards that has made Cory Marine Annunciators so widely adopted by the United States Navy and Merchant Marine.

For further information write for Bulletin 60-29-A.

CHAS. CORY CORPORATION

DIVISION OF BENDIX AVIATION CORPORATION

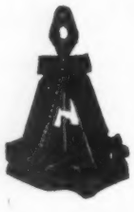
68-76 King Street **New York City**

Expanding Anchor

EVOLUTION

1929

1928


1927

1926

BETTER ANCHORS —
BETTER LINES —

COPPER · ALLOY STEEL, *known for its High Resistance To Rust,* **is now used exclusively in the manufacture of** Chance *Improved Expanding Anchors.*

NO ADVANCE IN PRICE!

The increased life of* COPPER - ALLOY STEEL *represents a BIG SAVING in the cost of your Expanding Anchors.

Always Two Steps Ahead

1929

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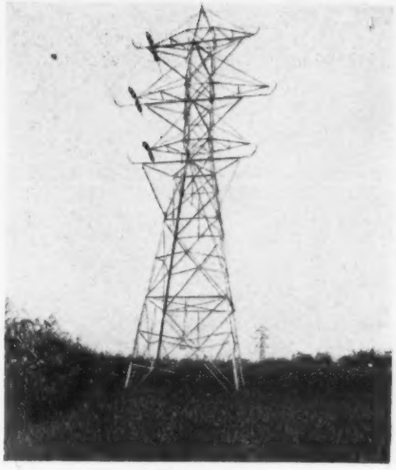
LEHIGH



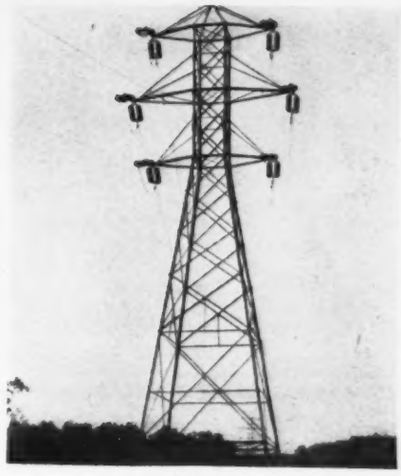
Towers

insures sound construction

Strength and security of construction contribute materially to economical central station operation—inside and out.

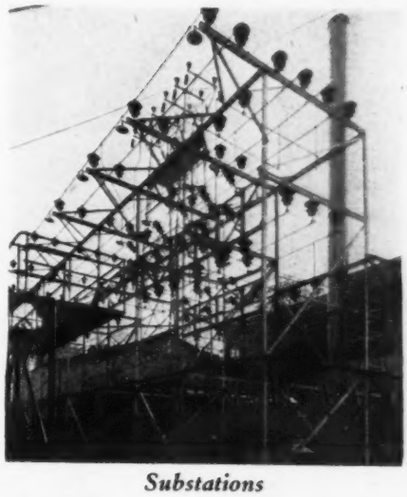
Lehigh Steel is meeting the construction requirements of many prominent central station companies. Everything from towers to coaling stations.

In considering your next construction job, let a Lehigh Engineer quote on your requirements.



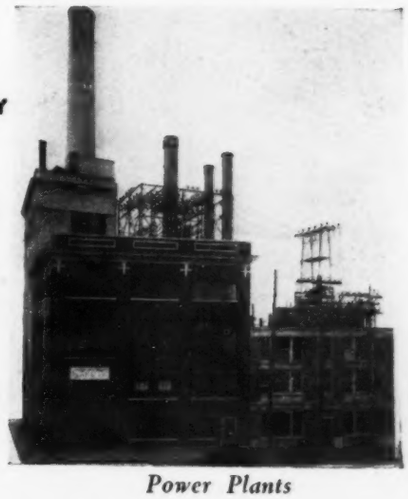
Towers

Steel Buildings



Substations

Coaling Stations



Power Plants

LEHIGH STRUCTURAL STEEL COMPANY

17 Battery Place, New York, N. Y.

WORKS: ALLENTOWN, PA.

Atlanta, Ga. Boston, Mass. Cincinnati, Ohio
Philadelphia, Pa. Sanford, N. C. Washington, D. C.

LSSC

How Linn Saves Time and Money on Hydro-electric Projects

Two of four Linn Tractors used by the Phoenix Utility Co. in construction of Ariel Dam near Woodland Valley in State of Washington. The Electric Bond & Share Co. are engineers on this $8,500,000 dam, which is to be 200 ft. high and 1,295 ft. long.

MOVING MOUNTAINS WITH LINN

It's some job to construct a dam like the Ariel—up near the top of the world. That's why the contractors purchased Linn Tractors to move the mountains of dirt. They have the giant power and sure traction necessary to carry capacity loads up steep grades, and over treacherous surfaces in all weather and under all conditions. The Linns on this job are equipped with high speed reverse that makes it possible to travel back and forth on passes where there are "no turns."

Linn has no weight-carrying axles or axle bearings—the exclusive roller chain assembly of its flexible traction transfers all weight directly to the ground. Thus the Linn's sturdy chassis can carry a ten ton load profitably where trucks cannot even operate.

Write for Linn surveys made by independent cost engineers; actual records show the dollars and sense reasons for the great and growing use of Linns in a wide variety of industries.

Only the Linn Offers You All These Advantages:

1. *Patented Flexible Traction* that grips any surface under all weather conditions.
2. Tremendous hauling power—100 horsepower to take full advantage of Linn Traction.
3. Ten ton capacity on its own chassis.
4. Extra traction and power for additional tow loads.
5. Easy on men—steers like a truck.
6. Four speeds forward—with four speed reverse optional.

LINN MANUFACTURING CORPORATION

Division of LaFRANCE-REPUBLIC Corporation

Manufacturers of American-LaFrance Trucks, Linn Tractors, Republic Trucks

Factories: Alma, Mich. Morris, New York

Represented in:

New York City	Boston	Philadelphia	Chicago	Tulsa, Okla.	Salt Lake City	San Francisco
Skowhegan, Maine	Charlotte, N. C.	Pittsburgh	St. Louis	Omaha, Nebr.	Denver	Portland, Ore.
New Haven, Conn.	Memphis, Tenn.	Louisville, Ky.	Kansas City, Mo.	Sioux Falls, S. D.	Jerome, Ariz.	Spokane
Baltimore	Johnson City, Tenn.	Detroit	Little Rock, Ark.	St. Paul, Minn.	Los Angeles	

105 direct distributors located throughout the United States and 49 distributors located in 30 foreign countries

Canadian Linn Distributors: Mussens Limited, Montreal

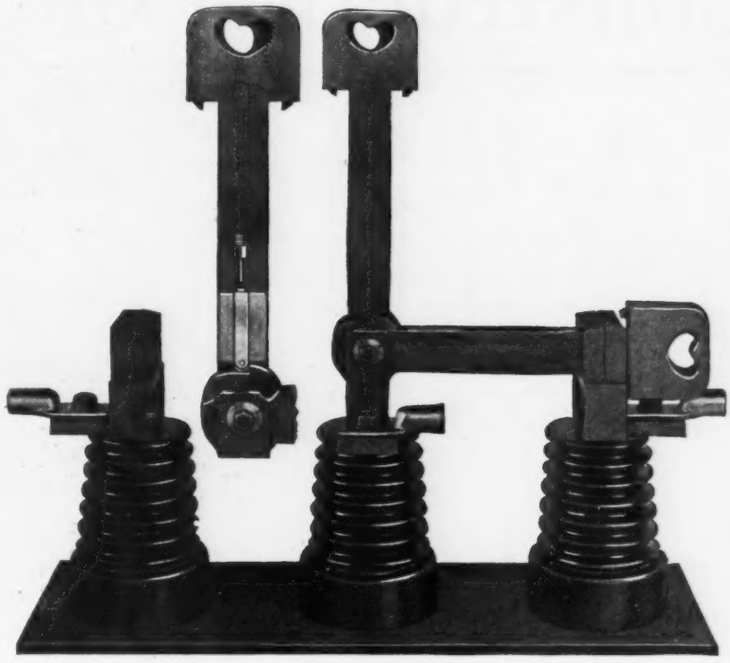
LA FRANCE REPUBLIC LINN TRACTORS

Patent No. 1,270,531
Patent No. 1,521,454
Patent No. 1,685,641
Patent No. 1,685,676
Patent No. 1,701,979
Other Patents Pending

A *New* Transfer Switch ▲ ▲ ▲

for Heavy Duty

safer and requires less space



DESIGNED and developed to meet limited space requirements, this Triple Lock Switch has met the approval of many of the country's leading central stations and consulting engineers. It is a double blade, single pole, double throw unit. Manufactured in capacities ranging from 300 to 1600 amperes and any voltage up to 15,000.

These switches provide for economical construction; existing transfer buses can be used without increasing the cell center spacings. Mounted on single-post insulators and 6 or 8-inch steel bases they require a minimum cell wiring assembly.

must be manually released

This switch has a positive locking feature in all three positions and lock must be released before it can be moved from one position to another. When switch reaches new position it automatically locks. The switch stick need not be removed at any time as the relative inclination of the handle operates the latch release.

Thoner & Martens manufacture a complete line of switches for heavy duty and make switches to meet any special requirements. We will gladly submit suggestions on any particular switch problem you may have.

"T & M" PRODUCTS

Disconnecting Switches

Transfer Switches

Selector Switches

Feeder Switches

A. C. and D. C.
low voltage
Switches
up to 20,000 amperes

Choke Coils

Potheads

Fuse Cutouts

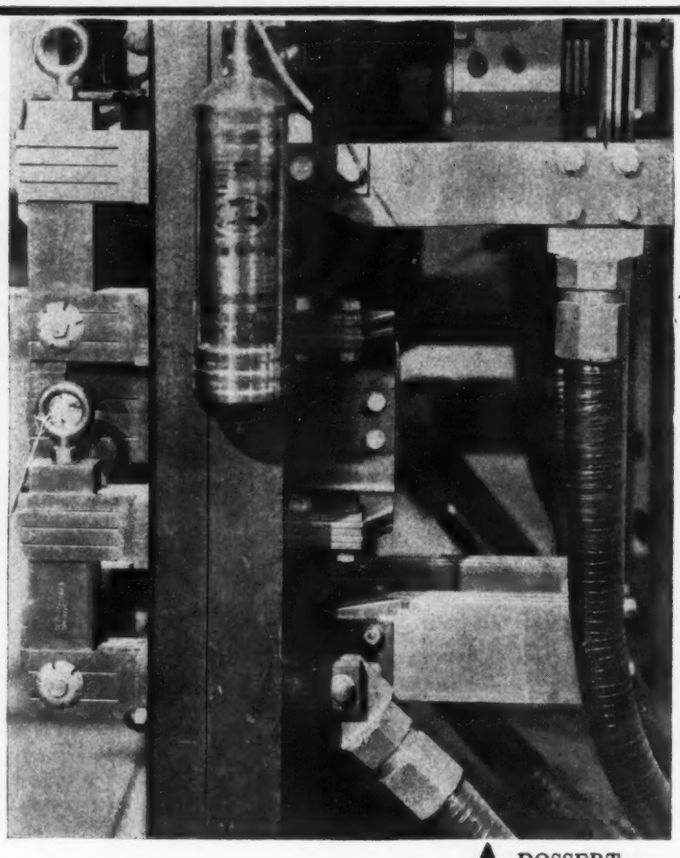
Send for a Catalog of "T & M" Products

THONER & MARTENS

Manufacturing Electricians

463 Commercial Street **Boston, Mass.**

Speaking of Design and Construction of Substations



Installation by
W. V. PANGBORNE & CO.
Construction Engineers
Philadelphia, Pa.

To Design Engineers:

In recent issues of this paper, heavy-duty Dosserts with laminated base terminals for 2,000,000 c.m. cables were illustrated.

The photo above shows these terminals on the knife switch connections in rear of a panel in the rotary room of the Carlisle Street Substation of the P. R. T. Philadelphia.

In the foreground you see the Dossert laminated base lug and the Dossert angle lug giving a workmanlike finish to the installation.

In designing station layouts, engineers will find the Dossert Line most helpful in layout as well as installation.

And the Dossert plant is always at the service of engineers in producing specially designed Dosserts for special applications.

Book showing the complete line—also containing valuable data on wires and cables—sent on application.

DOSSERT & CO., H. B. Logan, Pres., 242 W. 41st St., New York

It's a

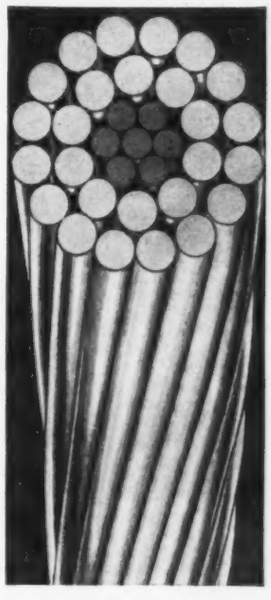
DOSSERT

Wet Snow is the loading hazard on this line . . .

temperatures vary from minus 10°F. to plus 105°F.

This is the Clarksburg-Parkersburg Line of the Monongahela-West Penn Public Service Co. System. Strung across the Appalachian Mountains, the line is subject, during late winter and early spring, to heavy, wet snow loading. In addition, it is exposed to temperature variations of from minus 10°F. to plus 105°F. To meet these conditions, A.C.S.R. 336,400 cir. mils—26 aluminum strands over 7 strands of steel—was used. The line is a 132 K.V., 3 phase single circuit. Average spans are 1048 feet; maximum, 1890 feet.

Crossing mountains, rivers, plains—in every type of terrain—A.C.S.R. brings remarkable economy and savings. Its steel core provides great strength, its Alcoa Aluminum strands combine light weight with high conductivity. Result—dead-load of wire reduced to the practical minimum and a high factor of safety obtained.



Using A.C.S.R. you can have: longer spans for the same sag; or lower structures for the same span. Alternatively you will secure a high factor of safety in the same span for the same sag.

Let us send you the booklets, "A. C. S.R. Sag Tension Calculations" and "A.C.S.R. Electrical Characteristics". Address ALUMINUM COMPANY *of* AMERICA; 2438 Oliver Building, PITTSBURGH, PENNSYLVANIA.

ALUMINUM CABLE

STEEL REINFORCED

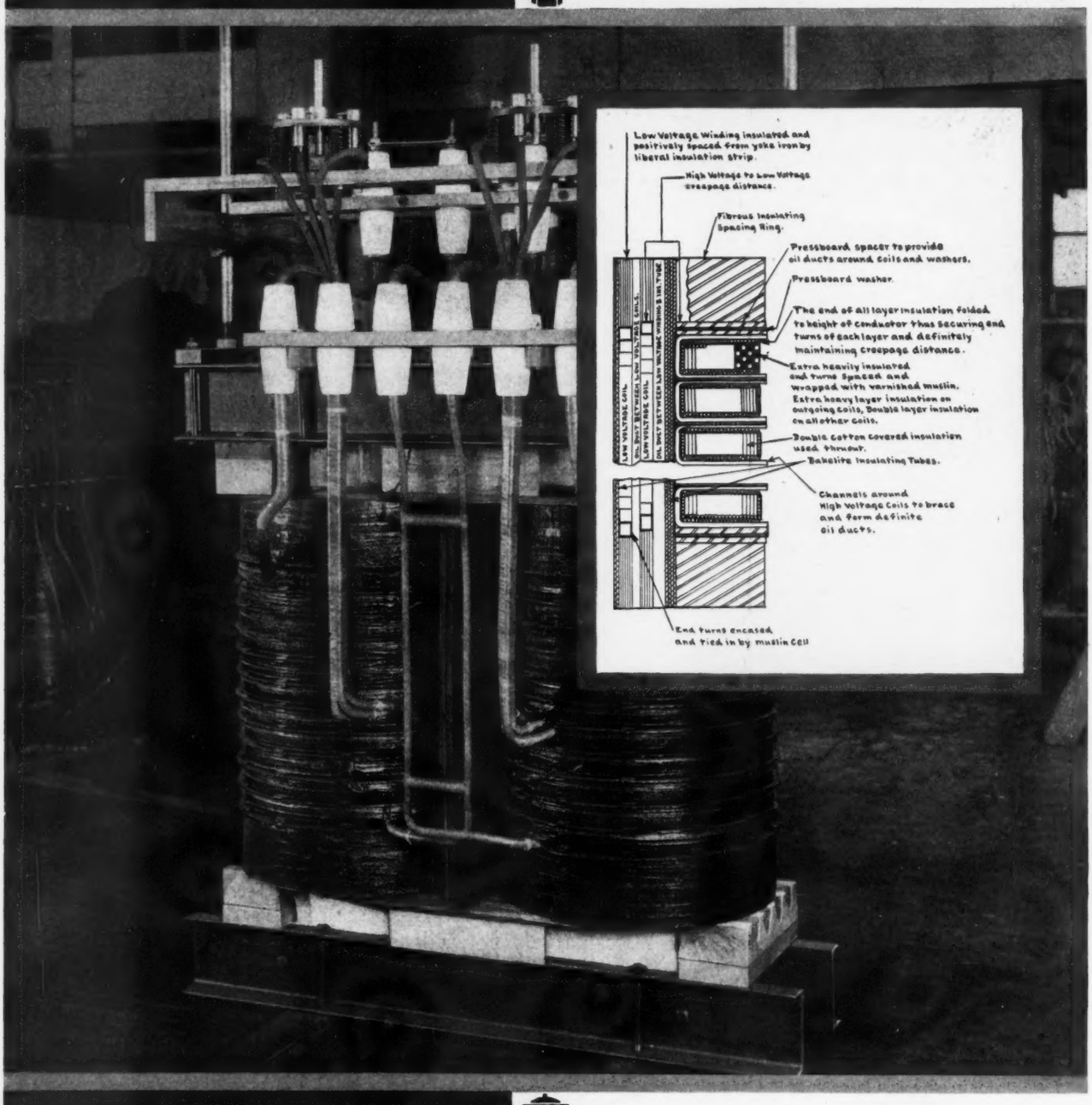
ALCOA

ALUMINUM

ALCOA ALUMINUM

Built to Give Uninterrupted Service

Wagner Transformer Coils are carefully and thoroughly insulated .... mechanically substantial and electrically safe .... The diagram is illustrative of Wagner coil ventilation .... the manner of applying insulation material to obtain low voltage per turn and per coil .... assuring long life and uninterrupted service.


Low Voltage Winding insulated and positively spaced from yoke iron by liberal insulation strip.
High Voltage to Low Voltage creepage distance.
Fibrous insulating Spacing Ring.
Pressboard spacer to provide oil ducts around coils and washers.
Pressboard washer.
The end of all layer insulation folded to height of conductor thus securing end turns of each layer and definitely maintaining creepage distance.
Extra heavily insulated end turns spaced and wrapped with varnished muslin. Extra heavy layer insulation on outgoing coils. Double layer insulation on all other coils.
Double cotton covered insulation used thruout.
Bakelite Insulating Tubes.
Channels around High Voltage Coils to brace and form definite oil ducts.
End turns encased and tied in by muslin coil

Wagner, Quality

Wagner builds a full line of Transformers ... Power, Distribution and Subway. Write for details.

WAGNER ELECTRIC CORPORATION

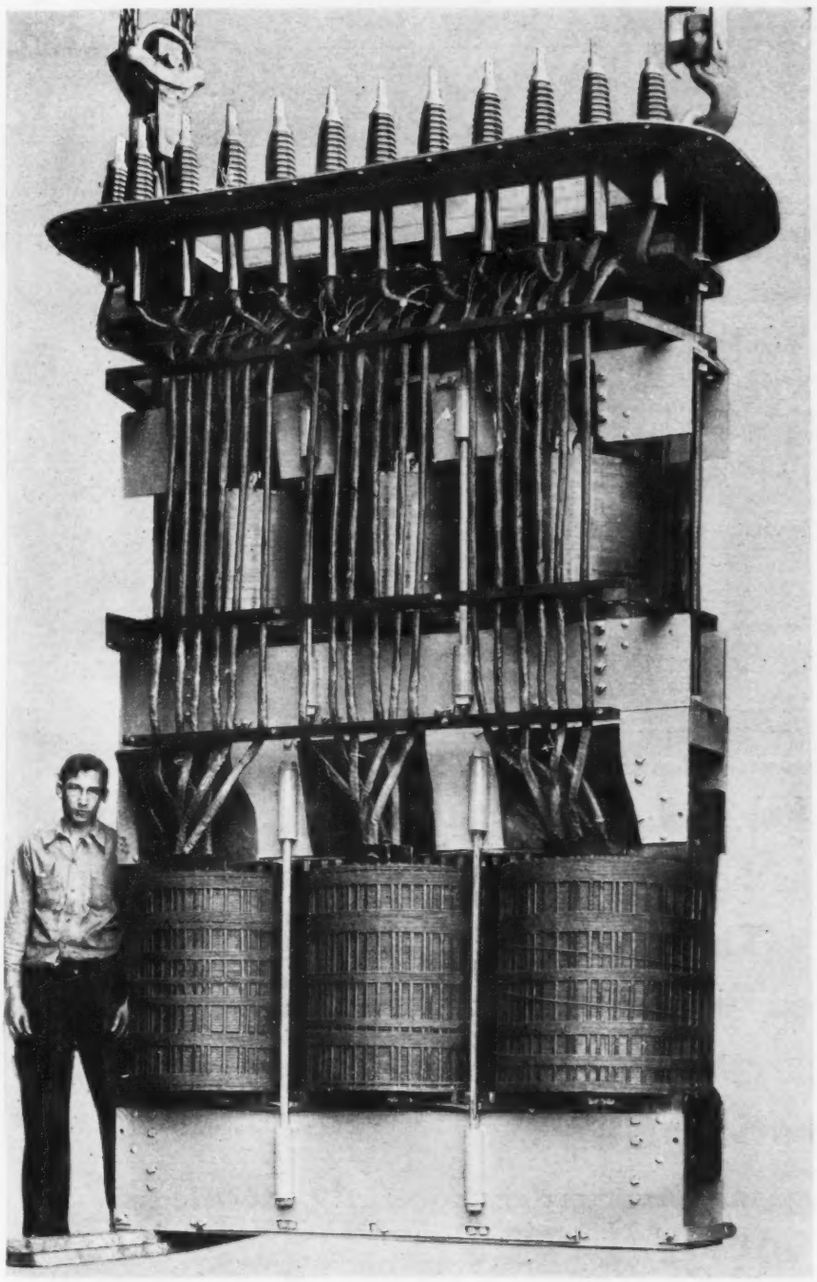
6400 Plymouth Ave., St. Louis

Sales and Service in 25 Principal Cities

PRODUCTS ... FANS ... DESK ... WALL ... CEILING
TRANSFORMERS ... POWER ... DISTRIBUTION ... INSTRUMENT
MOTORS ... SINGLE-PHASE ... POLYPHASE ... DIRECT CURRENT

61-6732-7

Customers Have Confidence in Our Ability!



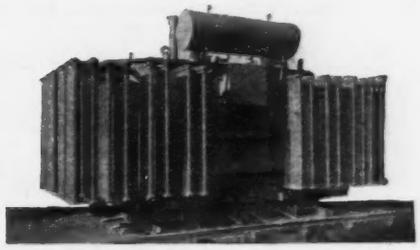
Designed to Most Rigid Specifications. Built for Most Severe Service

A thorough knowledge of the latest developments in the design and construction of power transformers was not sufficient for the production of the transformer shown at the left. A careful study was made of load and voltage stresses in transformer and reactor, balancing of heavy secondary multiple circuits, bracing, ventilating, and alternating the secondary leads, and the necessary cooling to take care of heavy overloads.

Two such transformers are now operating the largest malleable iron foundry in the country.

Pennsylvania Transformers were selected because they incorporate the very desirable combination of circular coils, for strength, and vertical oil ducts, for cooling.

All Pennsylvania Transformers, from the smallest to the largest are built on this principle.



The transformer on the flat car weighs 90,000 lbs. It is rated 6250 kva., 25 cycle, 12,000 volts, three phase, primary, 2300 volts, two phase, secondary, and was built for a large chemical company.

It will be to your interest to receive our quotations on your future transformer requirements.

Bulletin 104 will be gladly supplied.

PENNSYLVANIA TRANSFORMER CO.

28th Street and A. V. R.R., Pittsburgh, Pa.
Telephone:—Atlantic 2078

PENNSYLVANIA Heavy Duty TRANSFORMERS

P.T.

Sales Representatives

BIRMINGHAM—EBBERT & KIRKMAN CO., 321 Brown-Marx Bldg., Birmingham, Ala.
BOSTON—ARTHUR H. ABBOTT, INC., 88 Broad Street, Boston, Mass.
CHICAGO—J. W. MURPHY CO., 431 S. Dearborn St., Chicago, Ill.
CLEVELAND—GORDON H. GILDERSLEEVE, 439 Terminal Tower Bldg., Cleveland, O.
DETROIT—PENNSYLVANIA TRANSFORMER COMPANY, 2315 Dime Bank Building, Detroit, Mich.
HARTFORD—ARTHUR H. ABBOTT, INC., 64 Cambridge Street, Elmwood, Conn.
MADISON—WILLIAM J. HUGO, P.O. Box 404, Madison, Wis.
MINNEAPOLIS—JOHN A. CLARK ELECTRIC CO., 607 Foshay Tower, Minneapolis, Minn.
NEW YORK—LEE SKIPWITH & CO., INC., 369 Lexington Ave., New York, N. Y.

P.T.

Prompt shipment of poles, roofed and gained to meet your special needs—poles ready for the hole upon arrival—can be depended upon from ***International.*** The large stock always on hand—an adequate crew of skilled pole framers make quick shipment a positive assurance. Quality in poles—in treatment—in preservative is paramount to ***International.***

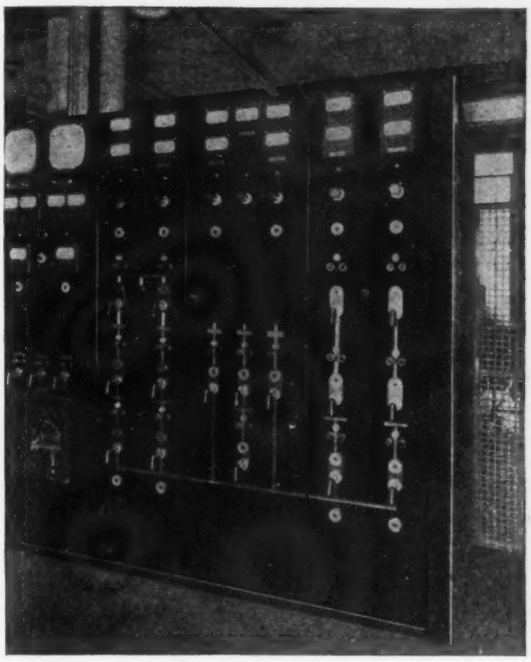
Large and small orders carefully executed.

3IC0
The International Dating Nail

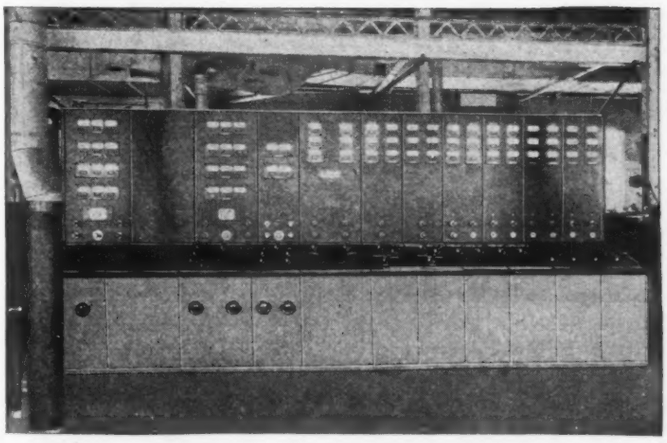
International Creosoting & Construction Company
General Office: Galveston, Texas

International Creosoted Yellow Pine Poles

NO FUSS --- NO BOTHER
and a Substantial Saving
with
Westinghouse Steel Switchboards



Front view of dead-front, dead-rear steel switchboard. Note flush-type instruments at top of panels.



Front view of steel bench board using flush-mounting, illuminated-dial, type W instruments.

WHEN Westinghouse steel switchboards are delivered at your generating plant or substation, your installation time is measured in minutes instead of hours, as compared with less modern types of boards. The reason is that steel boards, because of their light weight and strength, are completely assembled, wired and tested at the factory before shipment. All that remains for you to do is to set the board in place and make the external connections.

Then, too, all vertical wiring is eliminated from the back of the board. It is carried in vertical wiring channels formed by the panel sides. There are no panel mounting bolts to obstruct the front surface, and no supporting frame to set in place before installing the switchboard. And the stretcher-leveled steel takes a smooth finish in black or other colors, if desired.

D. M. F. 5181 gives complete information on these switchboards. Request a copy from our nearest office.

Service, prompt and efficient, by a coast-to-coast chain of well-equipped shops

Westinghouse

T 31504

TUNE IN THE WESTINGHOUSE SALUTE OVER N. B. C. NATION-WIDE NETWORK EVERY TUESDAY EVENING

Westinghouse
COMPENSATOR FOR VOLTAGE REGULATOR RELAY TYPE RC
24 VOLTS MAX. RESISTANCE COMPENSATION 5-8.7 AMPERES
24 VOLTS MAX. REACTANCE COMPENSATION 60 CYCLES
CONTROL CIRCUIT VOLTS
STYLE
NOTE – REMOVE THIS PLATE TO CHANGE RESISTOR TAPS FOR 110-120 OR 130 VOLT SECONDARY OF POTENTIAL TRANSFORMER
5 AMPERE SCALE
SCALE
SCALE
AMPERE SCALE

Type RC (rotary contactless) line-drop compensator for induction feeder regulators.

A CONTACTLESS *line-drop* COMPENSATOR

"MR. Lang, have you seen the new line-drop compensator for our induction feeder voltage regulator? This new type RC compensator is even better than the KC type with which you are familiar.

"It has no contacts of any sort . . . nothing to wear or burn or to give trouble. Think what this means to you.

"How do you eliminate contacts?" asked Mr. Lang.

"Two miniature induction regulators do the trick—so simply that it's a wonder no one thought of it before.

"These miniature regulators give smooth adjustment (no steps) from zero to 24 volts both resistance and reactance. And the circuit cannot accidentally open due to poor contacts."

Write our nearest sales office for complete information regarding this remarkably improved compensator.

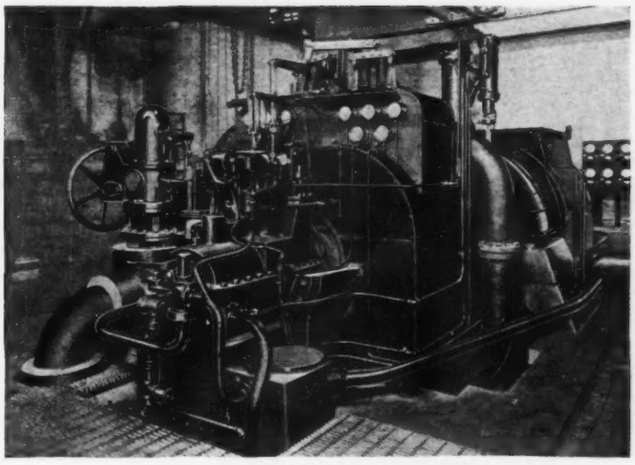
Service, prompt and efficient, by a coast-to-coast chain of well-equipped shops

Westinghouse

T 31498

TUNE IN THE WESTINGHOUSE SALUTE OVER N. B. C. NATION-WIDE NETWORK EVERY TUESDAY EVENING

TURBINE pays for itself *in* 3 *years*



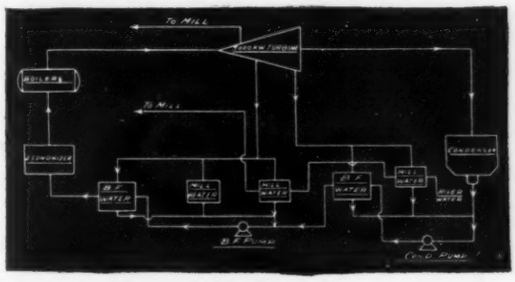
Westinghouse 5000-kw., Turbine-generator Unit installed at the Chase Metal Works plant of the Chase Companies, Inc., Waterbury, Conn.

THE Chase Companies, Inc., Waterbury, Conn., recently modernized their power plant equipment and installed a 5000-kw. bleeder condensing Westinghouse turbine-generator unit.

The steam that operates the turbine for power generation is again used in process work, for heating boiler feed water and the plant. The economies effected by this arrangement will pay for the entire unit within three years.

This is another example of the greater economy gained by the installation of a Westinghouse turbine when power generation is combined with process steam supply.

Engineers are available at our nearest office for consultation on effecting economies in your plant.



Diagrammatic arrangement of the heat balance of the turbine illustrated above. Steam is bled from the turbine at three points, for use in heating boiler feed water, process work and plant heating.

Service, prompt and efficient, by a coast-to-coast chain of well-equipped shops

Westinghouse

WESTINGHOUSE ELECTRIC

T 31480

TUNE IN THE WESTINGHOUSE SALUTE OVER THE N. B. C. NATION-WIDE NETWORK EVERY TUESDAY EVENING.

ECONOMY

in

DESIGN AND CONSTRUCTION

of

CELL STRUCTURES AND CELL DOORS

ENGINEERS who are seeking economies today—and who isn't—can be assured of a most economical and well constructed, complete cell structure job through this organization.

Whether you want—

DURITE
TRANSITE
or STEEL STRUCTURES

we can supply your needs.

Also, being the largest suppliers of cell doors, we are logically in the most favorable position to help you cut down part of your distribution system costs.

An opportunity to figure on your next cell structure or cell door job will convince you of the economies that can be effected.

GENERAL CELL STRUCTURE CORP.

BOSTON
E. C. Baugher
40 Court St.

Division F. R. GREENE & CO., Inc.
215 Fourth Ave., New York, N. Y.

PHILADELPHIA
P. T. Bradley
2401 Chestnut St.

RANKIN-DUTNEY CORP., 3600 Euclid Ave., Cleveland. Offices also in Pittsburgh, Detroit, Cincinnati

THE LARGEST MANUFACTURER OF CELL DOORS IN THE WORLD

"FRAHM"
VIBRATING-REED

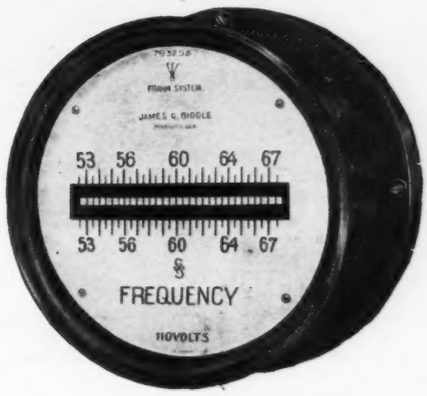
TACHOMETERS

No Belts—No Gears
No Electrical Connections

SIMPLY mount the "Frahm" Tachometer on the machine—in almost any convenient location—and that is all there is to it. It will operate for "years on end" and does not even have to be oiled.

For many years our "Frahm" Vibrating-Reed Tachometers have been standard equipment on steam turbines, high speed pumps, blowers, etc., for speeds between 800 and 12,000 r.p.m. They are specified by engineers who *know*, and are used by all turbine builders. Made in both round and rectangular patterns for stationary mounting and also in a smaller case for hand use. Write for descriptive Catalog 1240-W.

FREQUENCY METERS



No Pivots—No Jewels
No Rotating Parts

IT is significant that many switchboards which carry ammeters, voltmeters and wattmeters of various well-known makes are alike in one respect,—the frequency meters on them are "FRAHM."

These unique instruments are specified and used by engineers who appreciate quality and who require dependable accuracy. They are unaffected by temperature changes or by wave-form, they hold original calibration indefinitely, and rarely need repair.

"Frahm" Frequency Meters are made for all frequencies from 15 to 120 cycles, with one and two rows of reeds and in both switchboard and portable types. Write for new descriptive Bulletin 1270-W.

JAMES G. BIDDLE
ELECTRICAL INSTRUMENTS
1211-13 Arch St. Philadelphia

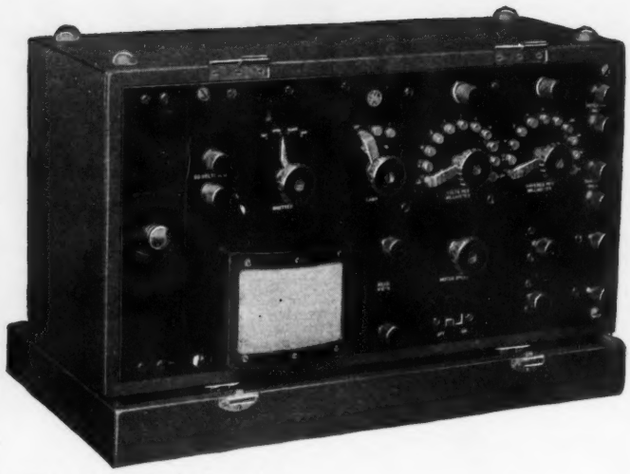
"Megger," "Meg" and "Super-Meg" Insulation Testing Instruments
"Megger" Ground Tester

"Megger" and "Meg" Direct-Reading Ohmmeters
Dionic Water Tester

Frahm Vibrating-Reed Frequency Meters and Tachometers

Jagabi Rheostats and Resistance Boxes
Precision Potentiometers
Siemens & Halske Precision Instruments

Jagabi Hand Tachometers, Tachoscopes, and Speed Indicators
and Oscillographs

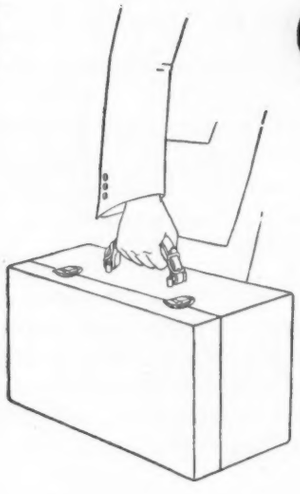


(Left) The Type PM-12 oscillograph with film holder in place for photographing recurrent phenomena

(Right) The Type PM-12 oscillograph, with viewing screen, as ordinarily used in classroom demonstration

This new two-element OSCILLOGRAPH

is a simple, portable instrument



THIS portable oscillograph is self-contained, and weighs only 30 lb., including the accessories in a built-in compartment.

It is an entirely new design for observing and photographing the *wave shapes* of the circuit current and voltage, just as an ammeter and a voltmeter indicate the *effective value* of current and voltage.

For use in the field, in the laboratory, or in the classroom, this oscillograph is truly portable, shows wave forms in proper phase relation, and is so simple that anyone can operate it.

The case is of high-grade walnut.

Described in Bulletin GEA-1209A.

JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

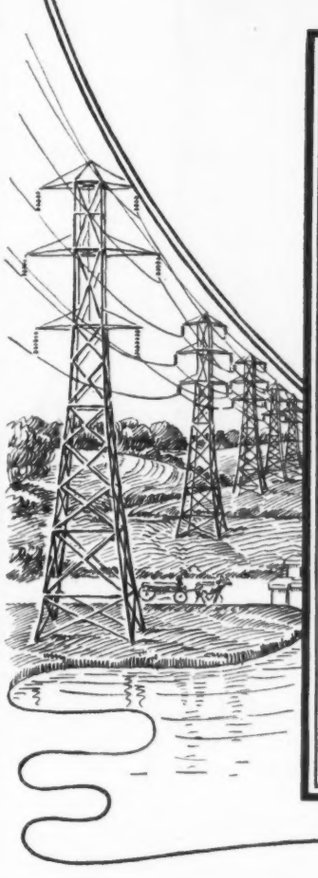
610-52

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

20 YEARS' EXPERIENCE— FULL EQUIPMENT—

At Your Service for Steel Tower — Wood Pole — Or Underground Transmission Line Construction



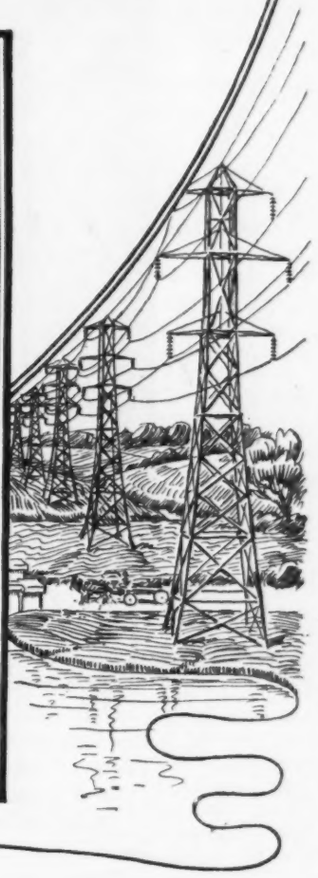
THE Kelso-Wagner Co. is ready to provide for you quickly a complete, thoroughly experienced, ably directed transmission building service.

Our service is well organized and well trained through years of experience. It saves you money, and no end of grief and trouble by taking over the whole job. You do not have to search for men, build and organize crews—your line crews can be kept to minimum.

You may purchase materials, or our organization will make all purchases according to your specifications.

Let our engineers confer with you on your next job—we will furnish an estimate for the complete job—steel tower—wood pole—underground—or substation.

WRITE TODAY



THE KELSO-WAGNER COMPANY ---- DAYTON, OHIO

Globar
REG. U. S. PAT. OFF.
BRAND

HELPING WINTER BROS. COMPANY TO GREATER PRODUCTION

IN the plant of Winter Bros. Company of Wrentham, Mass., famed as makers of high grade tools, one "Globar" Equipped Sentry Furnace equals the productive capacity of four oil-fired furnaces.

Here again we have an example of the high efficiency of high speed steel heat treating by electricity and again an evidence of the effectiveness of Globar Brand Electric Heating Elements—a combination that assures a clean, uniform, controlled heat; a uniformity of product; a superior quality of tools.

Globar Brand Electric Heating Elements literally make high speed steel heating temperatures possible.

When planning future production schedules it will pay you to investigate Globar Brand Electric Heating Elements.

In the meantime our Sales Engineering Department will gladly assist on any problem of electric heating

GLOBAR CORPORATION, NIAGARA FALLS, N. Y.

(A SUBSIDIARY OF THE CARBORUNDUM COMPANY)

Pacific Abrasive Supply Co., San Francisco and Los Angeles
Williams & Wilson, Ltd., Montreal-Toronto, Canada
Steinmetz & Company, Philadelphia

(Globar is the registered trade name given to non-metallic electrical heating and resistance materials, and to other products of Globar Corporation, and is its exclusive property.)

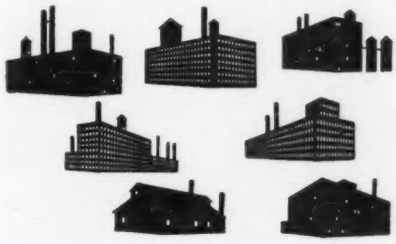
SEE OUR EXHIBIT AT
NATIONAL METAL CONGRESS—SPACE 53

BETTER INDUSTRIAL LIGHTING

THE MEETING GROUND WHERE THE INTERESTS OF ALL ARE SERVED

An Unusual Mutuality of Interest

The interest of the customer is served to an unusual degree in the development of the industrial lighting load. The immediate and continuing benefits that accrue to plant management and workers through better lighting makes this phase of central station business building close to the ideal in altruistic service.



More Than Half of the Existing Plants Need Better Lighting

In practically every center of industrial activity, more than half of the existing plants need better lighting. This is not because of negligence or indifference upon the part of industry. Rather it is because many industrial executives have not realized how far short of accepted standards their plant lighting really is.

An Income Building Load

Industrial lighting is in the classification of stern necessities when industry is pointing toward economy in production cost, use of space and strengthening of employe morale. And one 200-watt lamp burning for 300 working days or two 200-watt lamps burning for 4 hours over the same period will bring in the same load as all the lamps and a lot of appliances in a residence installation.

1) ——

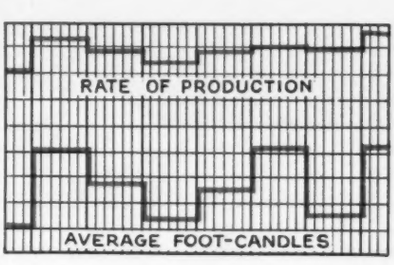
2) ——

3) ——

4) ——

Other Elements in the Industry are Benefited

While adding to the central station load, the electrical contractor, the jobber and the manufacturer of lighting equipment all participate. The graph above shows, relatively, *(1)* the value of reflectors sold; *(2)* the value of wiring devices sold; *(3)* the value of the wiring installed, and *(4)* the increased income to the central station in a typical better lighting campaign.



Better Light Makes Better Work

It has been established beyond any doubt that an increase in lighting intensity, at a very reasonable percentage of the payroll, is invariably followed by lowered production costs or other tangible and more or less intangible advantages or both. The graph above shows how the production curve fluctuated with the increase and decrease of lighting intensity in one plant, where over a 15 months' test it was clearly shown that a 25 percent increase in production per employe was secured at a cost of 2 percent of the payroll.

Better Lighting

- Increased Production
- Lower Production Costs
- Less Spoilage
- Fewer Accidents
- Improved Morale
- Less Labor Turnover

These are the material benefits that flow from better lighting—the demonstrated and understandable things that make for an appreciation of the mutuality of interest between the service of the light and power company and the industrial community it serves.

• • • •

With the lengthening of the periods of natural darkness and the greater instability of daylight during the months immediately before us, the betterment of the lighting system in factories, semi-industrial plants and other commercial places becomes of foremost importance.

We pledge our hearty support in the better lighting program of the Industrial Lighting Committee of the Society for Electrical Development. On request we will be glad to send to light and power companies, electrical leagues and other organizations full information on our own program for participating in these activities.

• • • •

Benjamin Electric Mfg. Co.

General Offices and Factory:

DES PLAINES, ILLINOIS
(Chicago Suburb)

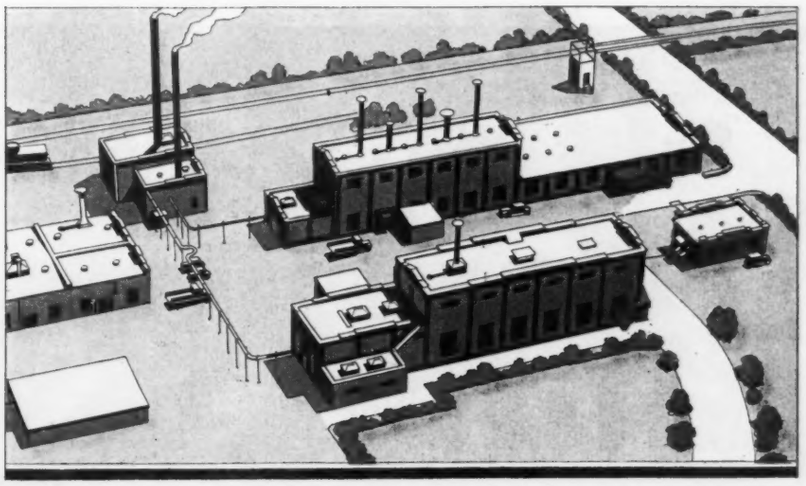
Divisional Offices:

New York — 247 W. 17th St.
Chicago — 111 N. Canal St.
San Francisco, 448 Bryant Street

VARTEX Seamless Bias-cut Tapes Wrap Smoothly Without Lumps

VARTEX
TRADE MARK
THE PEAK OF QUALITY

This VARTEX Trade Mark is on every package and roll of tape or fabric.



The VARTEX Factory at Woodbridge, N. J.

VARTEX varnished textiles also include yellow and black varnished cloth in 36 inch rolls and yellow and black straight cut tape in rolls of specified width.

BIAS-CUT tapes with sewed seams cannot be made without some excess thickness at every seam. These thickened places make little lumps and prevent uniform wrapping, which weakens the dielectric value of the insulation. Lumpiness cannot be eliminated in any tape with seams.

So VARTEX bias-cut tapes are made without seams. From end to end they are uniform and therefore wrap smoothly and easily to make perfect insulation.

VARTEX Seamless Varnished Bias-Cut Insulating tapes are made both yellow and black in any desired width and cost the same as sewed seam tapes of the same thickness and width. Specify them for all new work and for the repair work done on cables, motors, generators, transformers and other electrical machinery.

NEW JERSEY WOOD FINISHING CO., INC.

FOUNDED 1907

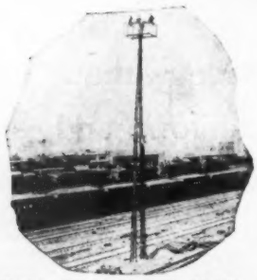
ELECTRICAL INSULATION DEPARTMENT

Woodbridge New Jersey

STATES Time Switches

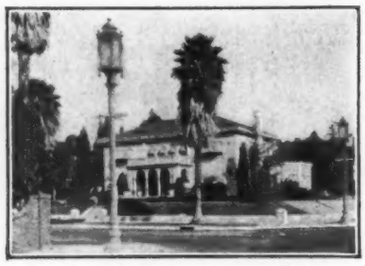
For the Automatic Time Control of

Flood Lighted Buildings . . . Illuminated Signs . . . Street Lighting . . . Landing Field Lighting (Boundary Lights, Beacons, Directional Lights) . . . Railroad Station and Platform Lighting.



Railroad and Airport Lighting

Illuminated Signs



Street, Park and Boulevard Lighting

STATES-SAIA Time Switches are playing a prominent part in many new lighting problems. Daily, these switches are being selected to control many of the world's important lighting jobs, because of the features that have made these switches known as the "world's finest."

Your careful attention is called to the following:

1. All STATES time switches are self-winding—electrically motor wound—fully automatic.
2. The motor has *no* carbon brushes, *no* revolving armature, *no* make or break contacts.
3. Fifteen jewel watch movement, invar balance wheel —operates accurately in all kinds of weather.
4. Revolving switch movement on *both* high and low tension models. Quick make and break action.
5. May be equipped with the astronomic dial which automatically adjusts itself to keep in step with changing sun time.

Catalog No. 4, Sec. 1, describes the STATES-SAIA low tension time switches, and Catalog No. 4, Sec. 2, describes the high tension time switches. Send for your copy today.

STATES TIME SWITCHES

—"the finest in the World."

Write to—

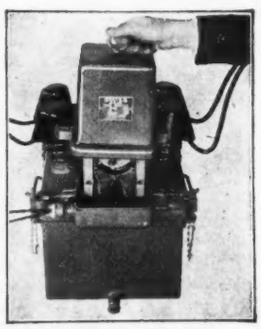
The STATES Company

43 New Park Ave., Hartford, Conn.

Branches in Many Cities

Type Z with astronomical dial.

Made in 6 to 200 amp. capacity.



Type HTSA high tension time switch.

Illustration shows cast aluminum cover being removed from clock, motor and dial. Made in capacities up to 8000 volts.

No. 18422

No. 18422-4W

The above illustration shows a four circuit enclosed branch cutout, wired and attached to the combination range and meter switch. A two-circuit branch cutout can also be supplied.

A New Member of The "Circle T" Line

A Combination Range and Meter Service Switch

In this Combination Switch, Trumbull has combined a range switch and meter service switch in a single housing. The two range circuit and the two line fuses are mounted on a single slate base.

Interlocked for safety, the fuse cover cannot be opened till the switch is thrown off, neither can the switch be closed until the fuse cover is shut.

The third wire for the line and range circuits is taken from a neutral terminal at the base of the switch.

Branch circuit cutouts can be attached by means of a single screw through the ¾" knockout.

Incorporating the sturdy qualities of "Circle T" manufacture, this new Trumbull switch solves many electric range switch problems.

Sold Through Wholesalers

THE TRUMBULL ELECTRIC MFG. CO.

A GENERAL ELECTRIC ORGANIZATION

PLAINVILLE CONN.

Branch Panelboard and Switchboard Factory at Ludlow, Kentucky

NEW YORK
803 Lincoln Bldg.

BOSTON
1002 Statler Bldg.

PHILADELPHIA
511-519 N. Broad St.

ATLANTA

A. G. Electric Mfg. Co., Division
Branch Panelboard and Switchboard Factories
Los Angeles Seattle

CHICAGO
2001 W. Pershing Rd.

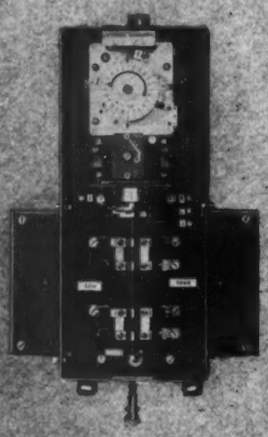
DETROIT BRANCH
415 Brainard St.

SAN FRANCISCO
432 Fourth St.

The "CIRCLE T" LINE

MAGNETIC & MANUALLY OPERATED MOTOR STARTING SWITCHES
TYPE "A" INDUSTRIAL SWITCHES
MOTOR CONTROL SWITCHES
TYPE "C" SWITCHES
ENTRANCE SWITCHES
METER SERVICE SWITCHES
SPECIAL SWITCHES
PANELBOARDS
SWITCHBOARDS
SAFE-CONVERTI-FUSE
"BUSS-WA"
(The Copper Bar Distribution System)
"FLEX-A-POWER"
(The convenience outlet for Power in Industry)
"CONTROLITE"
(The Theatre Control Board)
and other devices—all listed in Catalog No. 14

SAUTER TIME SWITCHES



ZMA Type 40 Amp. 2 pole, double throw switch, self-winding clock

ZME Type 15 Amp. 2 pole 40 day hand wound clock

ZM 40 II Type 2 pole 40 Amp. 125-250 volts

ZMO Type 100 Amp. 2 pole, self-winding clock, oil break switch

There's a *Standardized* SAUTER for every Time Switch Job!

The Sauter principle of standardization of main features in all types has definitely established its superiority in over a hundred thousand installations today. A standardization which means more simple, and economic installation, and lower maintenance.

The Sauter has an UNEQUALLED SERVICE RECORD in actual operation . . . a record of accuracy, dependability, and durability beyond compare. That's why more Sauter Time Switches were manufactured last year than any other high-grade switch.

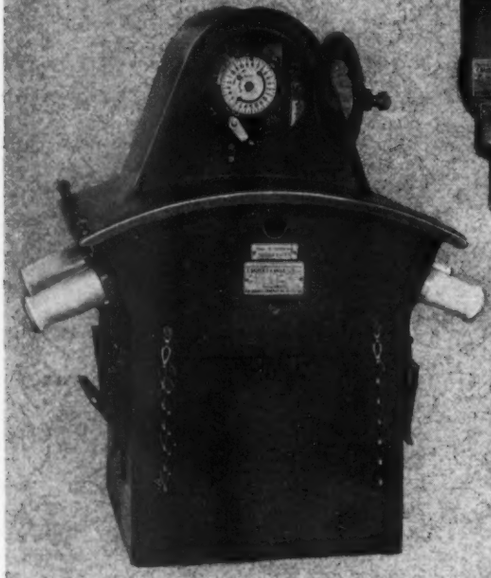
Universal Application A. C. and D. C.

Write for Catalog

SAUTER

Time Switches

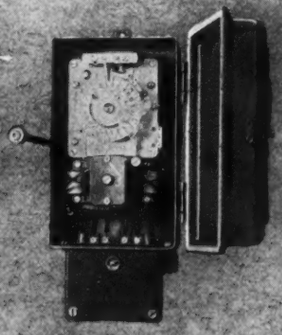
S-15—II Type, 15 Amp. 2 pole 14 day key-wound clock, 100/250 volts



HZ 46/25—II Type with astronomic dial 2-4600 Volts 25 Amp. 2 pole

40 day Key-wound Contact making clock for demand meters

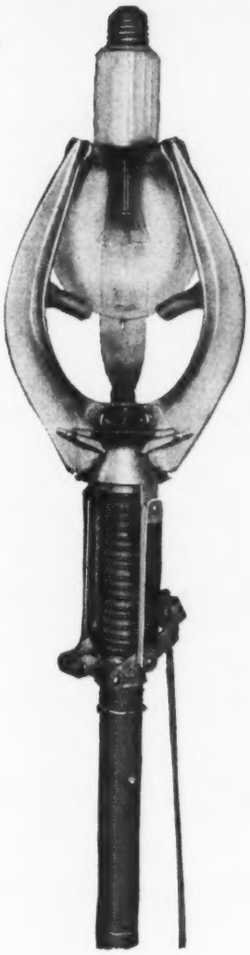
ZM 75—2 pole type in submersible housing



ZEE Type, 2 Amp. 1 pole self-winding with astronomic dial

R. W. CRAMER & COMPANY, Inc. **67 Irving Place, New York**

The G.C.A. Lamp Replacer



Speeds up the work and Lowers Maintenance Costs

RIGHT now executives are scanning every possible means of speeding up operations and at the same time of reducing costs.

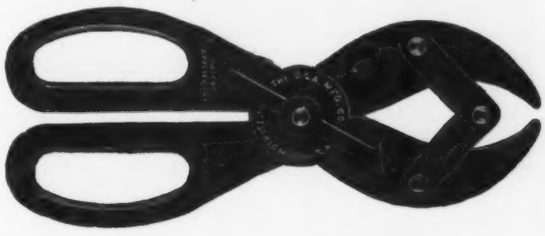
As a result many utilities have standardized on G.C.A. products.

The G.C.A. Lamp Replacer is a simple clutch mechanism mounted on the end of a sectional pole. Made in two types—one that pulls the socket with the old lamp and replaces the socket with a new lamp in it—and another that unscrews the old lamp and screws in the new. Each type is made in all models required to handle standard lamps and fixtures. Special models are available or can be designed for your special fixtures.

G.C.A. Fuse Plug Puller →

THE G.C.A. Fuse Plug Puller will remove and replace all types of primary cut out and pole line fuse plugs, both of the straight pull down and the quarter twist types. It may be attached to the same sectional handle that is used with the G.C.A. Lamp Replacer. No need for the line man to carry two handles.

G.C.A. Cartridge Fuse Tongs



SHOWN on the left, a new fuse puller for cartridge fuses from ½-inch to 1¾-inch diameter. It weighs less than 6 oz. and is small enough to fit in the pocket. Made of an insulating material containing a cloth compound—hence is strong and safe. No metal parts.

Write for full details about three (3) aids to cover maintenance costs. G.C.A. Equipment pays for itself so quickly that no public utility can afford to be without it. Write for catalog.

The G.C.A Manufacturing Co., Pittsfield, Mass.

"■ ■ ■ WE HAVE SELECTED WHEELER LIGHTING"

That is an often-heard statement in the world of industrial illumination. ■ Modern industry, in its demand for efficiency, has found in the scientific design and better performance of Wheeler Reflectors the solution to its lighting needs. ■ Throughout the country today, modern-minded Engineers, Architects and Contractors are showing a definite preference for lighting equipment bearing the Wheeler name. ■ That fact in itself is the strongest testimonial of Wheeler superiority that could be offered! ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

WHEELER REFLECTOR CO., BOSTON, MASS.

NEW YORK ATLANTA CLEVELAND

Sales Offices: St. Louis, Indianapolis, Los Angles, San Francisco, Seattle; In Canada: Canadian General Electric Co., Ltd

IRVINGTON INSULATION

It takes a "Mike" to find the seam in "IRV-O-FLATSEME"

Only .005 to .007 in. thicker than the body of the tape itself.

"IRV-O-FLATSEME" is the newest development in sewed bias cambric tape. It accomplishes the following results:

Thinnest possible joint in sewed bias . . . Surface roughness reduced to minimum . . . Double stitched—well insulated—sewed splices which will not separate under tension . . . More uniform thickness throughout tape length . . . Can be used on taping machines without jerking . . . Smoother wrappings with minimum of air pockets . . . Joints that will readily conform to irregular surfaces. Write for samples and prices.

Irvington Varnish & Insulator Company

Irvington, New Jersey

Established 1905

Sales Representatives

Mitchell-Rand Mfg. Co., New York
White Supply Co., St. Louis
E. M. Wolcott, Rochester
Martin Woodard, Seattle

Earl B. Beach, Pittsburgh, Pa.
Electric Insulation Co., Philadelphia, Pa.

Prehler Bros., Inc., Chicago
Prehler Bros., Inc., Cleveland
Clapp & LaMoree, Los Angeles
A. L. Gillies, Toronto

ATWATER KENT RADIO

with the GOLDEN VOICE

• • •

Here's your Ammunition!

MODEL 70 LOWBOY

Finished in American walnut with rubbed top. Matched butt walnut front panels and apron.

	Less Tubes
60 Cycles—110 Volts A. C.	$119.00
25 Cycles—110 Volts A. C.	$129.00
110 Volts Direct Current	$129.00
Battery Operated	$99.00

MODEL 74 TABLE

Finished in American walnut with matched butt walnut front panels, top and back. All four sides are finished. It may thus be placed anywhere in room.

	Less Tubes
60 Cycles—110 Volts A. C.	$125.00
25 Cycles—110 Volts A. C.	$135.00
110 Volts Direct Current	$135.00

One great line on which to *concentrate*—new inside and out—

Complete in its range of prospect appeal—

Magnificent new models—harmonious, satisfying—

Exclusive Quick-Vision Dial, for instant, accurate tuning—all stations always in sight and uniformly separated for easy selectivity on every part of the dial—

Perfected Tone Control, emphasizing bass or treble at will—four definite shadings of the Golden Voice—

Precedence in Screen-Grid—longest experience, a year in advance—

Amazing range and power—

And finally, Atwater Kent workmanship throughout.

NEW QUICK-VISION DIAL

—an exclusive Atwater Kent feature—the year's outstanding advancement

Entire dial in full view all the time, for instant reading from any angle. Uniform kilocycle graduations from end to end, widely spaced for easy tuning at every point—made possible by a wonderful compensating mechanism, developed in the Atwater Kent Laboratory. Velvety, accurate action. Large, legible figures, fully illuminated.

Prices slightly higher west of the Rockies and in Canada

MODEL 76 HIGHBOY

Finished in American walnut with rubbed top. Matched butt walnut front panels and doors. Doors muffled with felt for silence.

	Less Tubes
60 Cycles—110 Volts A. C.	$145.00
25 Cycles—110 Volts A. C.	$155.00
110 Volts Direct Current	$155.00
Battery Operated	$125.00

MODEL 75 RADIO PHONOGRAPH COMBINATION

Finished in American walnut with rubbed top. Matched butt walnut front panels and apron. Top piano-hinged and with automatic support. Ample and accessible record compartment.

	Less Tubes
60 Cycles—110 Volts A. C.	$195.00

ATWATER KENT MANUFACTURING CO. *A. Atwater Kent, Pres.* 4712 WISSAHICKON AVE., PHILADELPHIA, PA.

Long have Newport Electrical Sheets been recognized, among those who use them, for their efficiency.

Able engineering, modern manufacturing and testing methods enable us to produce a sheet that admits no superior.

As an example of Newport progressiveness we have recently placed in operation a new testing laboratory. It is equipped with the most modern testing apparatus obtainable, and is staffed by the ablest men at our command.

Send for our new booklet, "Newport Electrical Sheets." It depicts the reasons for the unusually high quality of Newport Electrical Sheets and why they are competitive only in price.

The
NEWPORT ROLLING MILL Company
Newport, Kentucky

THE skill of the plasterer means very little, unless he works with good mortar.

The beauty of a heating device is practically wasted unless combined with a good *heating-element*. A percolator, range, or electric furnace, so far as performance is concerned, are built around their heating elements. And good heating-elements are those made of Chromel. the original nickel-chromium resistor developed by A. L. Marsh in 1906.

The trustworthy behavior of this Chromel alloy is one of the main supporting factors in the field of electric heat. Its satisfactory performance has helped to sell heating devices to the home, and the use of electric heat by industry, in its processes. Teamed up with the unfailing service of the power company, Chromel has thus brought comfort and convenience to the home, and economy and better products to industry.

Chromel also has created for you a profitable heating load, that grows larger every day. Chromel is a friend of yours, as you are a friend to Chromel. Each needs the other. For useful, engineering data on Chromel, ask for Catalog GW.

And remember that . . .
. . . What good mortar
is to a plaster job . . .

Hoskins

is to the Electric

HOSKINS MANUFACTURING COMPANY

Chromel wire

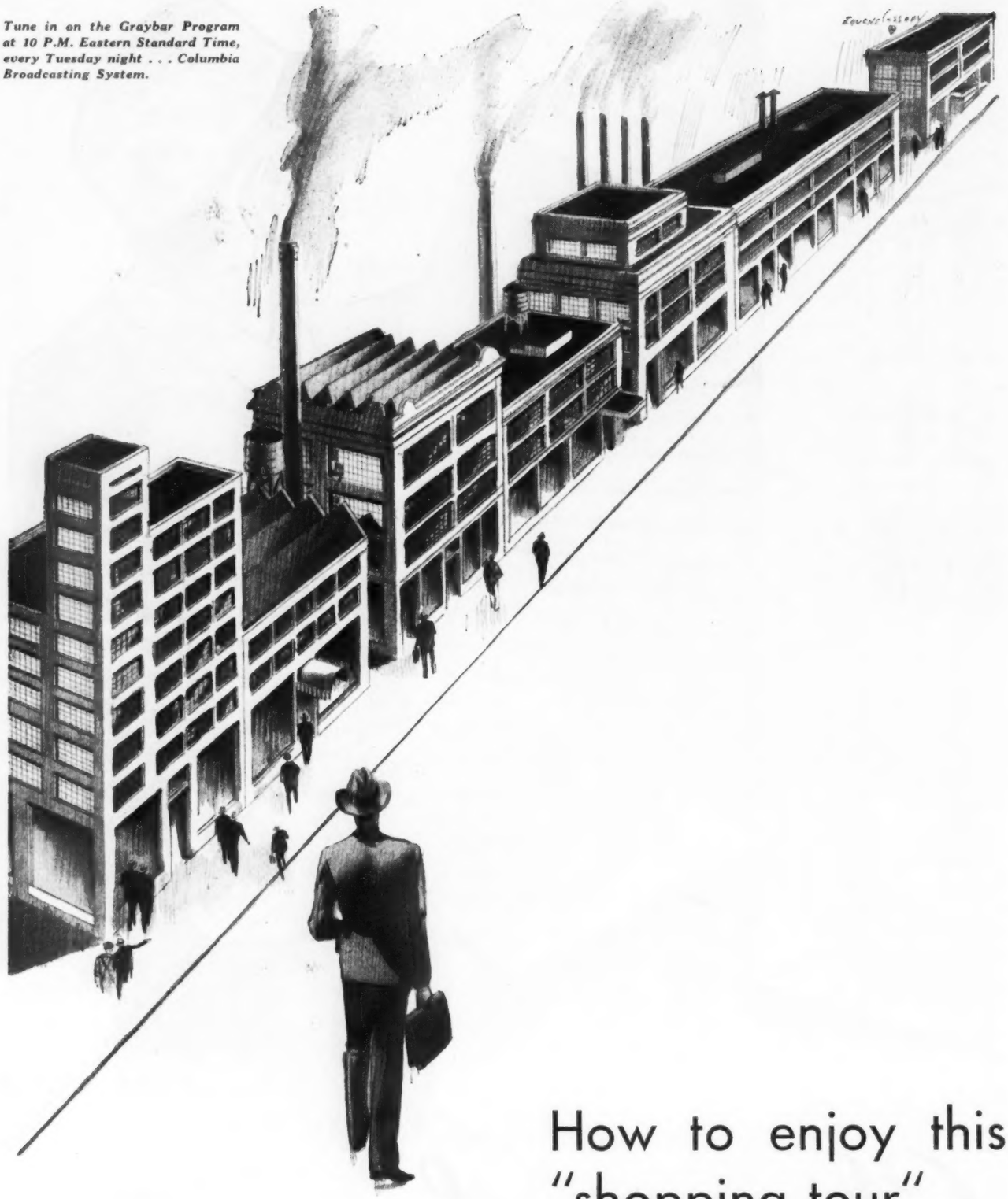
Heating Industry

4445 LAWTON AVENUE. DETROIT. MICH.

BOSTON. NEW YORK. CLEVELAND. CHICAGO. SAN FRANCISCO

IN CANADA
WALKER METAL PRODUCTS LTD.,
WALKERVILLE. ONT.

Tune in on the Graybar Program at 10 P.M. Eastern Standard Time, every Tuesday night . . . Columbia Broadcasting System.



How to enjoy this "shopping tour" . . .

(without having to make it) . . . One way is to let Graybar do it for you. Graybar makes available the 60,000 products of more than 300 electrical manufacturers in every local industrial "shopping district". And thereby eliminates for you all the costly and annoying delays of shopping all along the highways and buy-ways of industry.

OFFICES IN 76 PRINCIPAL CITIES. EXECUTIVE OFFICES: GRAYBAR BLDG., NEW YORK, N.Y.

GraybaR

SILVRAY

Glareless Illumination –

With blinding light sources in the field of vision, skilled hands soon lose their speed and accuracy. Efficient coordination of eyes and hands requires not only a sufficient amount of light but proper illumination as well.

Silvray has achieved true glareless industrial illumination by entirely removing the light sources from the field of vision and at the same time providing higher intensities on the working plane than any other comparable system of approved industrial lighting.

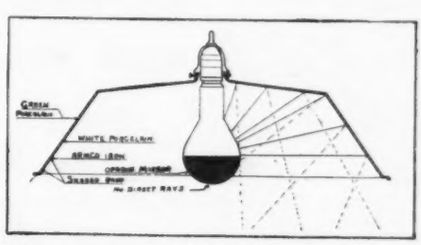
Through the Silvray process a pure silver reflector is applied to a standard lamp and then used in conjunction with a special porcelain enamel steel reflector. The reflector diffuses and directs the entire output of the processed bulb to the working plane, making possible the use of the highest working intensities.

The high efficiency of the indirect processed bulb also makes possible the sale of full indirect lighting on an economical basis and with maintenance entirely eliminated.

We would be pleased to submit for trial installation four units, either industrial or full indirect, on memo order from any power company customer.

1 Industrial Daylight
2 Higher intensity
3 **GLARELESS ILLUMINATION**
4 Perfect distribution
5 No objectionable shadows
6 Whiter light
7 Higher eye efficiency
8 Increased production
9 No additional maintenance
10 Moderate first cost

Write for the Complete Silvray Catalog. It tells the whole story of Silvray and its application to modern illumination.

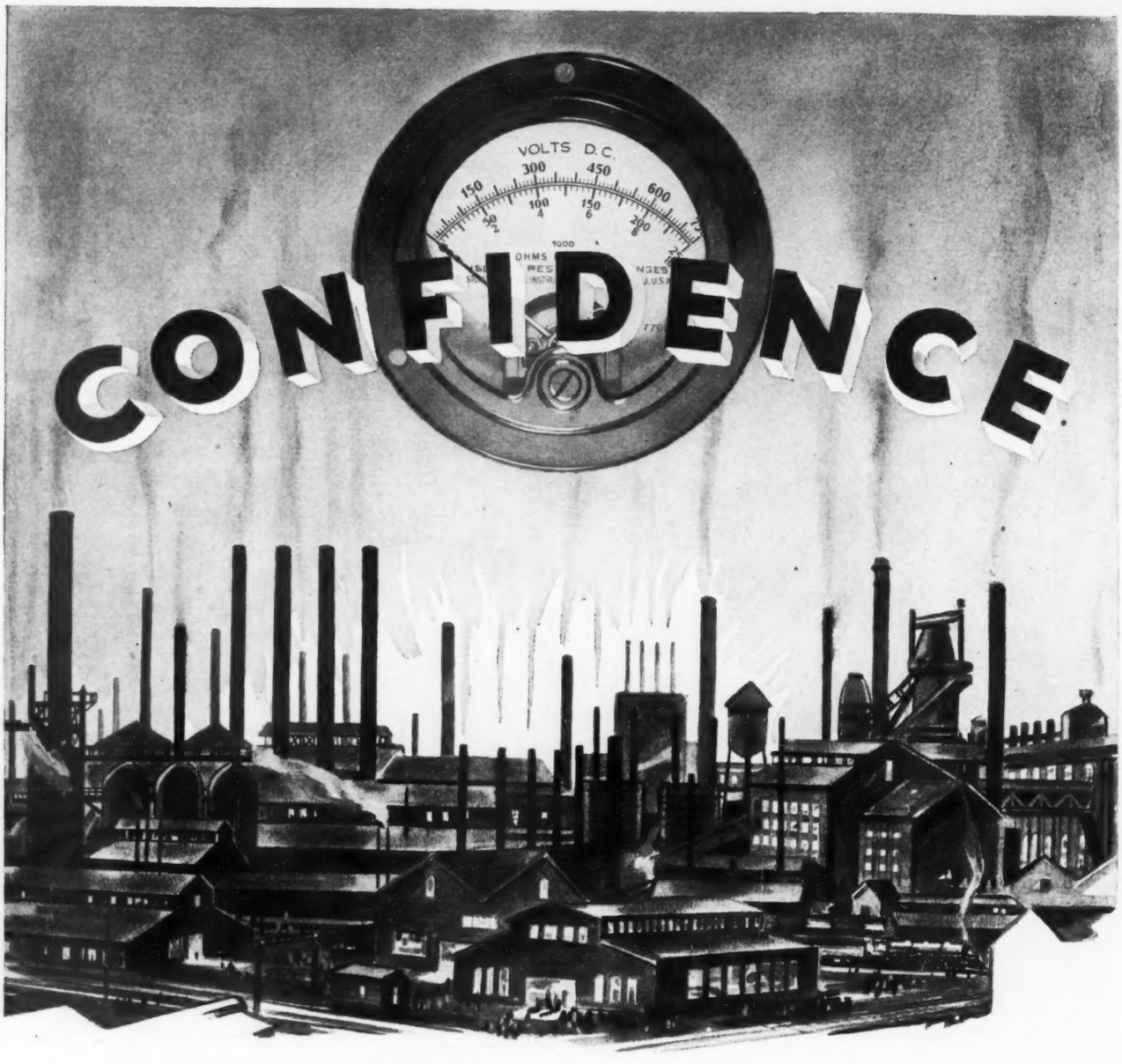


"Indirected Light for Industry"

This is the third of a series of advertisements explaining the outstanding features of Silvray. The next advertisement will feature Perfect Distribution.

The Silvray Process applied to your own lamps does not interfere with your lamp contract.

SILVRAY LIGHTING, Inc.
55 West 14th Street, New York City



The confidence that industry places in Weston Instruments has been earned by years of continuous and dependable performance.

Weston
PIONEERS SINCE 1888
INSTRUMENTS

WESTON ELECTRICAL INSTRUMENT CORPORATION
578 Frelinghuysen Avenue **Newark, N. J.**

When you need

Wire, Ribbon or Strip!

—to withstand corrosion,

—with a reasonably high tensile strength,

—that is heat-resistant,

—that is malleable,

—that is non-corrosive,

—that is machinable.

Specify—

Nichrome IV

High Temperature Service

Through a generation of research and development this company has built solidly until today it operates the largest plant in the world devoted to alloy products . . . . . melting furnace, rolling mills, technical control over every step of fabrication—plus the priceless ingredient EXPERIENCE assure not only quality but UNIFORMITY of quality, impossible to obtain by lesser qualifications.

DRIVER-HARRIS COMPANY
HARRISON, NEW JERSEY
Chicago-Detroit-Morristown, N. J. England-France
In Canada The B. Greening Wire Co., Ltd., Hamilton

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AMBURSEN CONSTRUCTION CO.
Incorporated
AMBURSEN DAMS
Hydro-electric Developments
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DAMS ON DIFFICULT FOUNDATIONS
Grand Central Terminal, New York
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HUGH L. COOPER & CO.
General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.
101 Park Ave. New York

HALL ELECTRIC HEATING COMPANY, INC.
Pioneers in Electric Storage Heating
Our engineering staff makes surveys of your off-peak profit possibilities.
1429 Walnut Street Philadelphia, Pa.

WILLIAM A. BAEHR ORGANIZATION, INC.
ENGINEERS—ACCOUNTANTS—MANAGERS
231 South La Salle St.
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SPECIALIZING IN THE CONSTRUCTION OF:
Railroad Electrification.
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Electrical Installations.
1654 Main Street Springfield, Mass.

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Consulting Engineers
Dams, Hydraulic, Hydro-Electric, Flood Control and Sanitary Projects
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Utility and Industrial Valuations. Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal. Factory Production and Cost Control Systems.
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36 State St., Albany, N. Y.

VICTOR A. DORSEY & CO.
Engineers
Public Utilities and Industrials
Examinations—Reports—Valuations—Management
Chicago, Illinois

HOOSIER ENGINEERING COMPANY
Erecting Engineers
Transmission Lines, Substations
100 W. Monroe St., Chicago, Ill.
225 Broadway, New York
Smith Tower, Seattle, Wash.

H. K. BARROWS
M. Am. Soc. C. E.
CONSULTING HYDRAULIC ENGINEER
Hydro-electric developments—Water supplies
Reports, plans, supervision.
Advice, appraisals.
6 Beacon St., Boston, Mass.

ELECTRICAL TESTING LABORATORIES
Electrical and Mechanical Laboratories
Tests of Electrical Machinery, Apparatus and supplies. Materials of Construction, Coal, Paper, etc. Inspection of Material and Apparatus at Manufactories.
80th St. and East End Ave., New York

GEO. L. HOXIE
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ENGINEERING ECONOMICS
306 W. 3rd St. Los Angeles

BATTEY & KIPP
Incorporated
ENGINEERS
Power Plants, Electrification Developments, Industrial Plants
Railway Shops and Terminals,
Design, Construction, Investigations. Appraisals.
231 S. LA SALLE ST., CHICAGO

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DISTRICT superintendent desires new connection with electric utility. Experienced with Eastern utility as cadet engineer, accountant, distribution engineer and district superintendent. Married, age 26. For complete résumé of references, education and experience write PW-699, Electrical World, 520 No. Michigan Ave., Chicago, Ill.

ELECTRICAL installation, chief electrician or construction foreman. Have had broad experience in power houses, industrial plants, construction and maintenance; also in the manufacturing of switchboards. Will go anywhere. PW-682, Electrical World, 520 No. Michigan Ave., Chicago, Ill.

ELECTRICIAN, 36, all around maintenance man with Utility or Industrial Plant. Available immediately. Go anywhere. Box 164, Wauna, Ore.

ELECTRICIAN, 26, all around maintenance man A.C. and D.C. armature winder with utility or industrial plant. Availale immediately. Go anywhere. PW-694, Electrical World, Tenth Ave. at 36th St., New York.

LECTRO-MECHANICAL engineer, single, 33, American citizen, four years' power and four years' industrial experience, seeks responsible technical or commercial-technical position with American concern in South America or Eastern Europe. Speaks Italian and French fluently, knowledge of German. PW-661, Electrical World, Tenth Ave. at 36th St., New York.

ENGINEER, electrical, 20 years' experience power plant, industrial, construction, maintenance, Westinghouse electric service engineer for 6 years. A-1 references from previous employers. Go anywhere. PW-697, Electrical World, Tenth Ave. at 36th St., New York.

GRADUATE, with extensive experience in construction of all kinds of motors and generators from ¼ kw. up to 75,000 kva., desires change. PW-701, Electrical World, Tenth Ave. at 36th St., New York.

POSITIONS WANTED

HYDRO-ELECTRIC and tunnel construction engineer, C. E. graduate of prominent technical school, class 1912: seven years' experience on hydro-electric dams, tunnels, deep shafts, intakes, power houses, and transmission lines (preliminary investigations, locations, and construction). Also had railroad, municipal and general engineering experience, both preliminary and construction. Experienced in use of aerial photographs. Desires position with responsibility as resident engineer or equivalent on hydro-electric or tunnel work. Will go anywhere except tropics. Available October 15. PW-685, Electrical World, Tenth Ave. at 36th St., New York.

METERMAN, 31, single, thoroughly familiar with all phases of metering and instrument installation, test and repair. Desires change, capable of supervising and developing department. Location immaterial. PW-700, Electrical World, Tenth Ave. at 36th St., New York.

POSITION wanted by electrical and mechanical engineer as electrical engineer or chief electrician for central station or industrial plant; experienced station, sub-station and distribution, new business, motor applications, maintenance. 20 years' experience engineering and sales. PW-696, Electrical World, 520 No. Michigan Ave., Chicago, Ill.

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Acquainted Cleveland district and with reputation for effectiveness, technical education or equivalent. Established lines of electrical and mechanical equipment. Substantial opportunity for the man big enough. Give full details. SW-650, Electrical World, 501 Guardian Bldg., Cleveland, O.

Salesman

Experienced in automatic motor starting equipment for industrial plants and machinery manufacturers. State age, education, experience and compensation expected. SW-698, Electrical World, 520 No. Michigan Ave., Chicago, Ill.

U. S. Government

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., Sept. 19, 1930.—Sealed proposals will be opened in this office at 3 p.m., Oct. 17, 1930, for furnishing the materials and performing the work required for installing one freight elevator in the U. S. post office, etc. at Lafayette, Ind. The successful bidder will be required to furnish a performance bond of 50% of the contract price. Drawings and specifications may be obtained from this office. JAS. A. WETMORE, Acting Supervising Architect.

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Westinghouse, 1250 kva., 2300 volt, 3600 r.p.m., 2 phase, 60 cycle with turbine and condenser. LOCATION—Canton, Ill.

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Westinghouse, 2300 volt, 3 phase, 60 cycle with Rice & Sargent and Chuse engines. LOCATION—Mattoon, Ill.

TURBO GENERATOR

General Electric, 2300 volt, 3 phase, 60 cycle with Terry turbine and Worthington condenser. LOCATION—Paris, Ill.

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Public Service Bldg., Springfield, Ill.

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MOTOR GENERATOR SETS

1—500 kw., 250 v., Westinghouse Synchronous motor Generator Set.

1—250 kw. 230 v., 3 ph., 60 cy., 2300-4600 v. Synchronous Motor Generator set.

1—200 kw., 230 v., 3 ph., 60 cy., 2300-4100 v Synchronous Motor Generator set.

1—150 kw., 600 r.p.m., 250 v., Gen., 3 ph., 60 cy. 220-440 v., G.E. Synchronous motor.

1—125 kw., 250 v. Westinghouse Synchronous Gen. Motor Set, 3 ph. 60 cy. 230 2200 v.

1—100 kw., 125 v., D.C. 220-440 A.C. G E. Synchronous Motor Generator Set, 220-440 v.

1—100 kw., 250 v., Gen., 900 r.p.m., 2200 Synchronous Motor.

1—85 kw., 250 v. 1200 r.p.m., 3 ph., 60 cy., 220-440 v., G.E. Synchronous Motor.

1—75 kw., 250 v. Generator, 3 ph., 60 cy., 2200 v., Synchronous Motor.

1—60 kw., 125 v., C.W., 3 ph., 60 cy., 220-440 Motor.

1—50 kw., 250 v., Westinghouse 3 ph., 60 cy. 220-440 v.

TURBINES

1—75 kva., 3 ph., 60 cy. Westinghouse Geared Non-Condensing Turbine.

TRANSFORMERS

—1500/3000 kva. G.E. combined oil and water cooled 3 ph., 60 cy., 11000-22000-2300 v.

3—500 kva. G. E. 13000/26000—220/440.

3—500 kva. G. E. 13200—2300.

A.C. GENERATORS

No.	Kw.	R.p.m.	Volts	Ph.	Type
1	1200	600	2300/4100	3	G.E.
1	350	600	440	3	Westg.
2	125	900	2300	3	Cr.-Wh.
2	100	900	230-2300	3	G.E.
1	75	600	220	3	Westg.
1	75	900	2300	3	G.E.
1	50	1200	220-440	3	G.E.
1	50	1200	2300	3	G.E.

MOTORS—3 Phase, 60 Cycle

No.	Hp.	R.p.m.	Volts	Type
1	1500	600	2200/4000	G.E. syn.
1	600	900	440/2200	G.E. slip ring
1	500	900	440-2200	G.E., slip ring
1	350	900	2200/4000	Wh. syn.
2	300	600	445-2300	G.E. syn.
1	250	600	2200/4000	G.E. syn.
1	250	600	220-440	Westg. syn.
1	250	600	440-2200	G.E. syn.
3	200	514	4150-2300	G.E. syn.
4	150	1200	220/440	Westg. sl. rg.
1	150	900	2300	G.E. syn.
2	150	514	2200	Westg. sl. rg.
1	150	1800	2200	Westg. sq. cg. mtr
1	100	900	440-2200	G.E. sq. cg.
1	100	900	220-440-220	Westg. sq. cg.
1	75	600	220	G.E. sq. cg.
1	75	600	220	Fair.-M. sl. rg.
1	75	490	440	Allis-Chal. sl. rg
1	75	900	2200	G.E. Kt.
1	60	1200	220	G.E. sl. rg.
1	60	720	220-440	G.E. Kt.
1	60	300	220-440-230	Fair.-M. syn.
1	50	600	2200	G.E. MT sl. rg.
1	50	900	2200	G. E. B.
1	50	1200	220-440	Wagner sl. rg.
1	40	1700	220-440	Westg. sl. rg.
1	40	1200	220-440	G.E. Kt.
1	25	900	440-2200	Cr.-Wheeler
1	25	1200	440	G. E. K.

(2 Phase Motors on Request)

B. T. S. MOTORS

2—175 hp., 3 phase, 60 cycles, 2300 volts, G. E., Variable Speed, Complete.

BRAND NEW MOTORS

No	Hp.	R.p.m.	Volts	Type
1	40	900	220-440	Gen. Electric KT
1	40	1200	220-440	Gen. Electric MT
1	30	1200	220-440	Gen. Electric KT
1	30	900	220-440	Gen. Electric KT
5	25	900	220-440	Gen. Electric KT
4	25	600	220-440	Gen. Electric KT
1	15	1200	220-440	Gen. Electric KT
2	15	1200	220-440	Gen. Electric MT
1	10	1200	220-440	Gen. Electric MT
5	7½	900	220-440	Gen. Electric MT

D.C. Generators

No.	Kw.	R.p.m.	Volts	Type
1	200	900	250	G.E.
1	200	600	250	G.E.
1	200	525	250	G.E.
2	150	1200	250	Cr.-Wheeler
1	150	600	250	G.E.
2	150	1200	250	Westg., new
1	100	720	250	G.E.
1	75	450	250	Dieh l
1	50	600	250	Westg.
1	30	1000	250	Westg.

(Smaller Sizes on Request)

D.C. MOTORS—230 VOLT

No.	Hp.	R.p.m.	Type
1	250	550	G.E.
2	200	1150	Cr.-Wheeler
1	150	600	G.E.
3	150	850	Westg. SK, new
1	150	1100	Westg. SK.
1	125	550	Cr.-Wheeler
1	100	625	Westg. Type S
1	80	500	Allis-Chal.
2	75	475	Westg. Type S
1	50	560	Westg. Sk.
1	50	650	Sprague
1	40	400	Dieh l
1	40	1300	Dieh l
1	35	200	Dieh l
1	35	700	Cr.-Wheeler
1	35	420	Dieh l
1	20	665	Dieh l
1	20	200	Dieh l
1	20	900	Dieh l

(Smaller Sizes on Request)

D.C. MOTORS—125 VOLT

No.	Hp.	R.p.m.	Type
1	125	575	G.E.
1	100	600	G.E.
1	80	600	G.E.
3	25	1200	Sprague
1	20	650	G.E.
1	15	775	SK Westg.

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GENERATOR

200 kw. Allis-Ch., 3 ph., 60 cy., 220 v. 900 rev. Generator with Exciter.

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Good Used Motors and Machine Tools
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We buy modern type transformers—any size—any quantity.

HIGH GRADE STANDARD EQUIPMENT

SLIP-RING MOTORS—3 Ph. 60 Cy.

Hp.	Volts	Make	Speed
500	2200	G.E.	1200
500	2200	G.E.	900
400	440	Allis-Cha .	450
350	2200-440-220	G.E.	720
220	220-440	G.E.	450
200	2200-440-220	G.E.	600
150	220-440	G.E.	720
150	220-440	Westghse	1200
150	220-440-550	G.E.	600
100	2200	Westghse.	900
100	550	G.E.	720
100	440-220	Allis-Chal	900
100	440-220	G.E.	720
100	440-220	G.E.	900
75	440-220	G.E.	900
75	550	G.E	720
75	550	G.E.	900
50	220-440	G.E.	900
35	220	G.E.	600
25	220-440	G.E.	720

SYNCHRONOUS MOTORS—3 Ph., 60 Cy.

Hp.	Volts	Make	Speed
325	2200-440	G.E.	200
300	440	G.E.	225
240	2200-440	G.E.	720
150	2300-4000	G.E.	900
135	2200-550	G.E.	900
80	440-220	Westghse.	1200
80	2200-440-220	G.E.	1200

DIRECT CURRENT MOTORS

Hp.	Volts	Speed	Make	Type
225	230	635	Westghse.	SK
100	230	1150	G.E.	LC
50	600	1450	Westghse.	SK
50	230	1050	G.E.	RC
50	115	565	G.E.	DLC
40	230	750	G.E.	RC
35	230	850	Westghse.	SK

DIRECT CURRENT GENERATORS

Kw.	Volts	Speed	Make	Type
200	250	850	Westghse.	SK
90	250	1150	G.E.	RC
50	125	725	G.E.	DLC
40	250	850	G.E.	RC
35	250	1050	Westghse.	SK

SQUIRREL CAGE MOTORS—3 PH., 60 CY.

Hp.	Volts	Make	Speed
300	2200-440	G.E.	514
200	2300-4000	G.E.	514
200	2200	Westghse.	600
200	4600-2300	Westghse.	1800
150	2200	Westghse	720
100	220-440	G.E.	720
100	2300-4000	G.E.	720
100	220-440	G.E.	1200
100	220-440	G.E.	900
75	220-440	G.E.	900
75	220-440	G.E.	720
75	220-440	G.E.	1200
75	2200	Allis-Chal.	1200

MOTOR GENERATOR SETS AND ROTARY CONVERTERS

1—165-kw., 125-250-v., 6-ph., 60-cy., 1200-r.p.m. G.E., with 2300-4000-v., 3-ph., transformer.
1—125-kw., 125-v., 1200-r.p.m., G.E., MPC, connected to ATI, 440-220-v., 3-ph., 60-cy., syn. motor.
1—100-kw., 250-v., 3-ph., 60-cy., 1200-r.p.m., Westghse., with 2300-v. transformer.
1—65-kw., 250-v., 1200-r.p.m., G.E., R.C. connected to KT, 440-220-v., 60-cy., squirrel cage motor.

A. C. GENERATORS

1—250-kva., 200-r.p.m., 2200-440-v., G.E.
1—187-kva., 720-r.p.m., 2200-440-220-v., G.E.
1—120-kva., 900-r.p.m., 2300-4000-v., G.E.
1—100-kw., 900-r.p.m., 2200-240-480-v., G.E.
1—75-kva., 1200-r.p.m., 2200-480-240-v., G.E
1—62 ½-kva., 1200-r.p.m., 240-480-v., Whse.
1—56-kva., 1200-r.p.m., 240-480-v., G.E.
1—50-kva., 1200-r.p.m., 2300-480-240-v., G.E.
1—30-kva., 1200-r.p.m., 2300-480-240-v., Whse.

TRANSFORMERS

3—Moloney, 500-kva., 60-cy., 13200-460-v.
3—G.E., 150-kva., 60-cy., 2300-230-460-v.
3—G.E., 100-kva., 60-cy., 2300-230-460-v.
3—G.E., 75-kva., 60-cy., 2300-230-460-v.

STEPHEN HALL & CO., INC., 7th and Adams Sts., HOBOKEN, N. J.

TURBO GENERATORS

3750 kva. G.E., 3, 60, 2300.
1875 kva. G.E. Extraction type.
1250 kva. G.E., 19 stage, 3, 60, 2300.
750 kva. Allis, Mixed Pressure.
625 kva. G.E., 3, 60, 440/220.
375 kva. G.E., 3, 60, 2300/440.
250 kva. Westgh., 3, 60, 220.

A.C. MOTOR DRIVEN PUMPS

400-hp. G.E. synchronous to Worthington, 3 stage pump.
500-hp. G.E. synchronous to Midwest pump.

TRANSFORMERS

1000 kva. G.E., 11000x2300/550, 3 ph.
4—500 kva. G.E., NEW 2300x110/220/440.
1—500 kva. G.E., 11000x2300/550, 3 ph.
3—333 kva. Allis, 2300x460.
4—300 kva. NEW G.E., 33000/66000, with taps to 5500/11000, 3 ph.
3—300 kva. G.E., 13200x440.
2—200 kva. G.E., 2200x600.
3—150 kva. Pittsburgh, 2200x110/220.
5—100 kva. Westgh. 2300x110/220.

Many smaller sizes.

MOTOR GENERATORS

500 kw., 250 v. G.E., 3 ph., 60, 4000-2300-440.
200 kw., 125 v. Crocker-Wheeler, 2 or 3 ph., 2300.
150 kw., 600 v. Westgh., 3 ph., 4000/2300.
90 kw., G.E., 250 v., 3 ph., 220 v.

Turbines, Transformers, Motor Generator Sets, Engine Generator Sets, Motors of all Kinds.

George Sachsenmaier Co.
8401 Hegerman St., Holmesburg, Phila., Pa.

POWER PLANT EQUIPMENT

Turbo Units

10,000 Kva. Westinghouse, 2-3-60-2300-13,200.
9,300 Kva. General Electric, 3-60-6600.
3,125 Kva. Westinghouse, 2-3-60-2200.
1,875 Kva. General Electric, 3-60-2200.
1,500 Kva. General Electric, 3-60-600 non-cond.
625 Kva. General Electric, 3-60-440-220-2200.

Boilers and Boiler Equipment

4—604-hp. Straight Tube B.&W., A.S.M.E. 200 lbs.
2—200-hp. HRT Bigelow, Mass. Std. 125 lbs.

Coal Crushers, Elevators, Conveyors, Larries

2—Turbine Driven Blowers, 28,000 to 60,000 cu.ft.
1—5,000-hp. Cochrane Open Heater.
1—17-in. and 10-in.x15-in. Worthington Feed Water Pump.

Compressors

5,930 cu.ft. Ingersoll-Rand PRE-2, 3-60-13,200.
2,200 cu.ft. Chicago OCE, 3-60-2200.
Also many other compressors, electric, steam, and belt driven.

Generators

200 Kw. Westinghouse M.G. set, 250 v. d.c.
500 Kva. G.E., 600 RPM, 3 bearing Gen., 3-60-600.
625 Kva. Ridgeway Engine Set, 3-60-2300.
450 Kva. G.E. Skinner Engine Set, 3-60-2300-550-140-220.
1500 Kva. Syn. Condenser, 3-60-600, 900 RPM.

A. LEE ELLIS
50 High Street, Boston, Mass.
"The Buyer Must Be Satisfied Always."

Meters and Transformers

271—Electric Meters, G. E., West. and Sangamo, Types 114-15-16; OA-OB; H and HC, 25 and 60 cy.
17—Polyphase Meters, G.E., D6-7-8, 25 cy.
83—Current Trans., G.E. and West., pri. 2400 to 7500 v., 5 amp. to 1200 amp.
12—Potential Trans., G.E., pri. 2300 and 6600 v., 25 and 60 cy.
1—30 kw. C.C. Trans., pri. 2200 v., sec. 6.6 amp., 60 cy.
4—(3-5 kw. and 1-10 kw.) C.C. Trans., pri. 2300 v., sec. 6.6 amp., 25 cy.

In good condition—attractively priced.

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300 kva. minimum can use up to 600 kva., 2400 volts, 2 or 3 phase, 60 cycles. Quote price for immediate shipment.

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HIGH POTENTIAL CABLE

Asked for by Central Station Engineers
We built it. It solves a problem for all time

THE excellent performance of ROCKBESTOS boiler room wires and cables for 600 volt service under conditions of heat, heat and moisture (as in conduit) fumes, oil and fire hazards, brought about a desire on the part of power company engineers for a similar type of insulated cable built for higher voltages up to 7500.

To create additional dielectric strength for these high voltages, layers of varnished cambric are placed between the felted asbestos walls. Maximum protection is afforded the layers of varnished cambric by the surrounding walls of compactly felted asbestos and impregnating compounds.

The outer felted asbestos wall protects from external high temperatures and the internal felted asbestos wall protects from possible heating of the copper. With this construction, there is no deterioration of the cambric.

This Rockbestos AVC Cable is giving the same satisfactory performance in high potential circuits under conditions of heat and moisture, as other Rockbestos cables are giving in low potential circuits.

These cables are being used for transformer leads, feeder cables and connections to oil circuit breaker and transformer.

They are also being used successfully in place of bare copper busses. Hand wrapping is eliminated.

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Bulletin No. 10 gives complete constructional data of these cables. Send for a copy.

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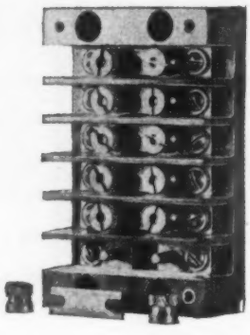
—the wire with permanent insulation

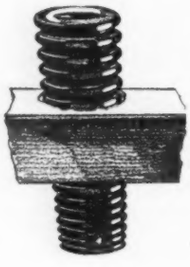
Electrose is now in use everywhere throughout industry



The block at the left was made for use in the East Weymouth station of the Edison Illuminating Co. of Boston. The removable links enable the operator to make his tests quickly and easily. Information on all Electrose products on request.

Another form of terminal block is shown at the right. This is developed to form a larger writing space for noting wire destinations and functions. This feature greatly simplifies testing and repairing. This block is now ready for general distribution in several sizes.

For bushings—Electrose is the weather resisting high tension insulation



Electrose has been before the trade for many years. In fact it has grown up with modern power service and is firmly established in generating station service. Electrose scored a triumph in outdoor insulation, proving beyond a doubt its superiority for moulded high tension insulation. At the same time its weather resisting qualities—its remarkable indifference to vapor and dust-charged atmosphere gave it its place in central station construction.

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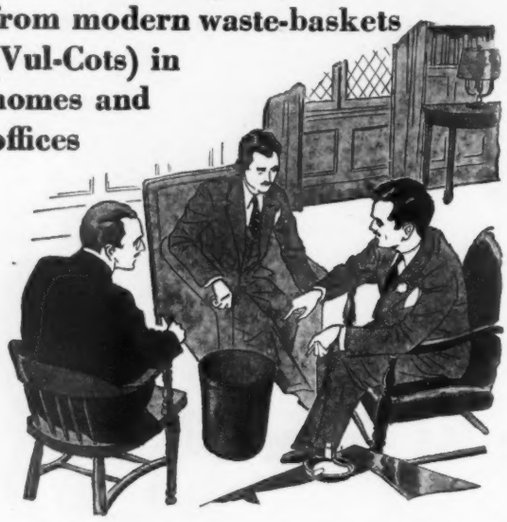
Thinking in the right material

Hunting for every idea that can give their own company any advantage in this new competition of value-giving,—more and more men and managers are analyzing, with "the manufacturing mind," every product in which Vulcanized Fibre or Phenolite is used. Picking ideas wherever they find them. And finding plenty.

What they can learn

from modern waste-baskets (Vul-Cots) in homes and offices



WITHOUT vulcanized fibre—the right kind of NVF—the perfected waste-basket of today would not have been possible.

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Vulcanized Fibre for electrical insulation and mechanical uses. For forming and all cutting operations. Ten standard kinds including Peerless Insulation and Leatheroid. Also Phenolites,—reinforced laminated Bakelite materials,—of many special formulae. Direct NVF representatives in principal cities of the United States, Canada, and Europe.

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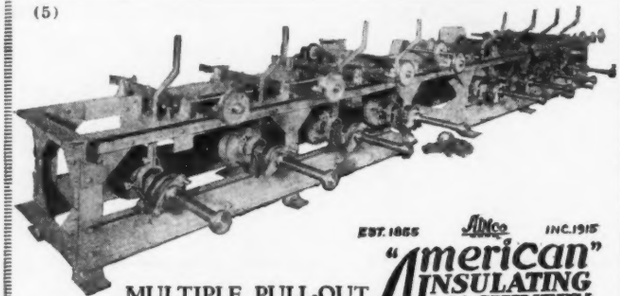

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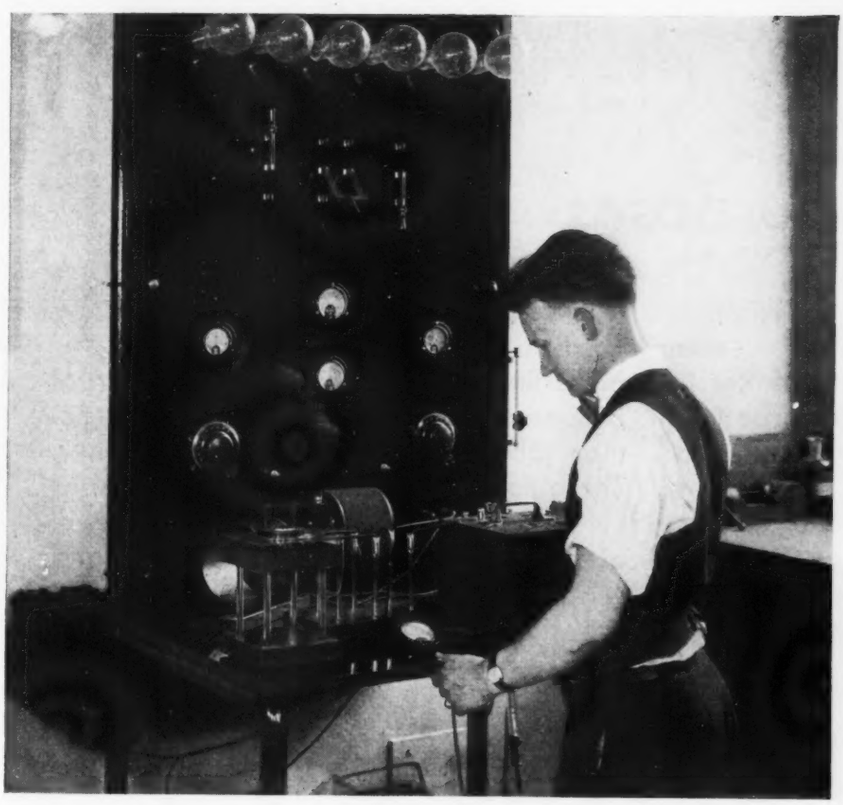

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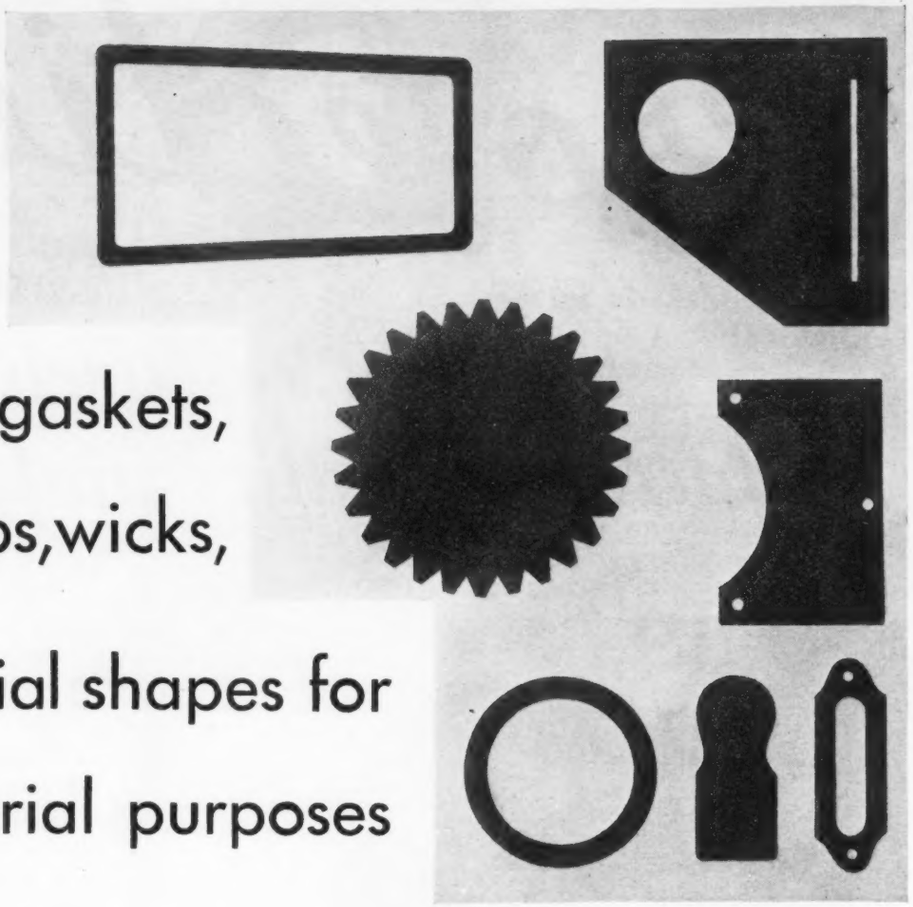

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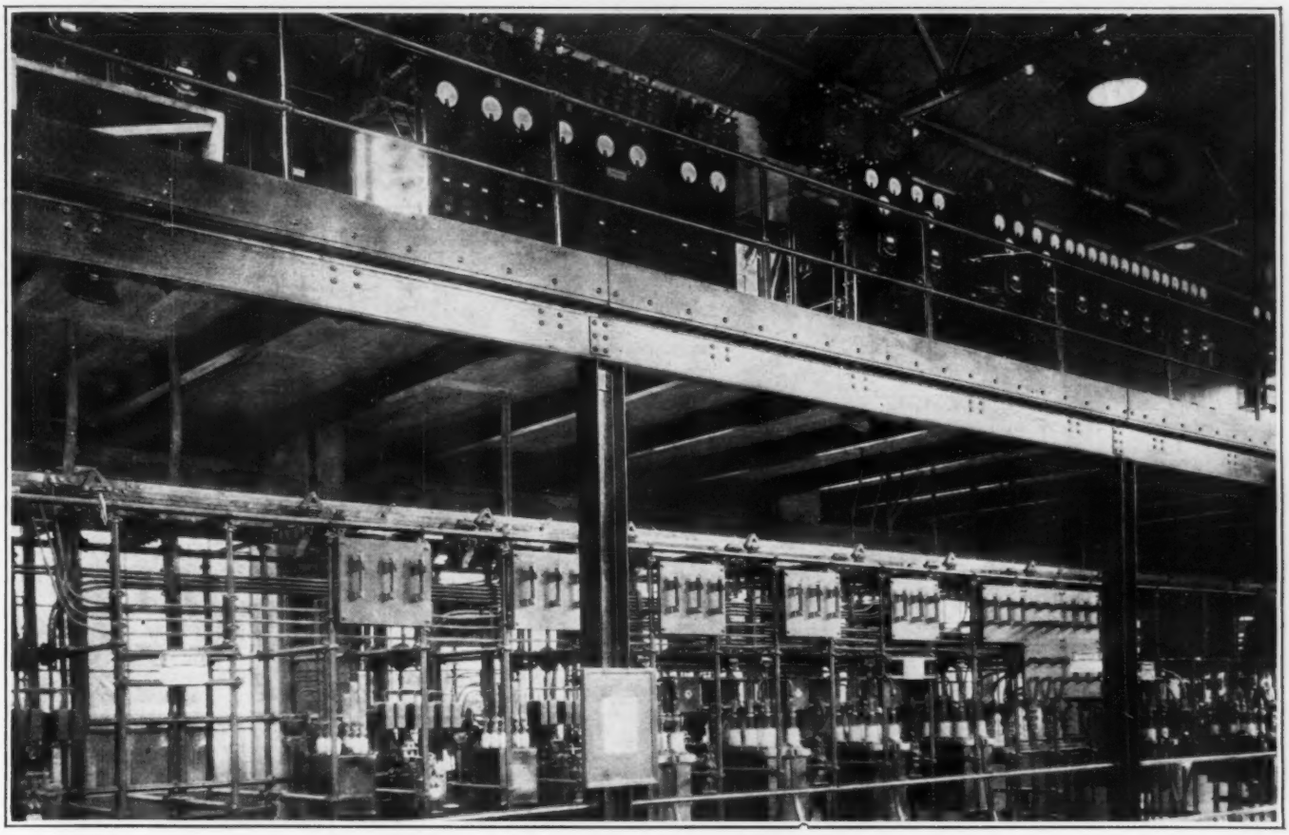

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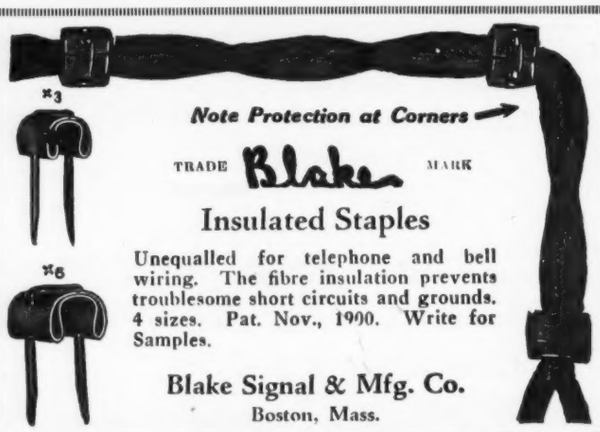

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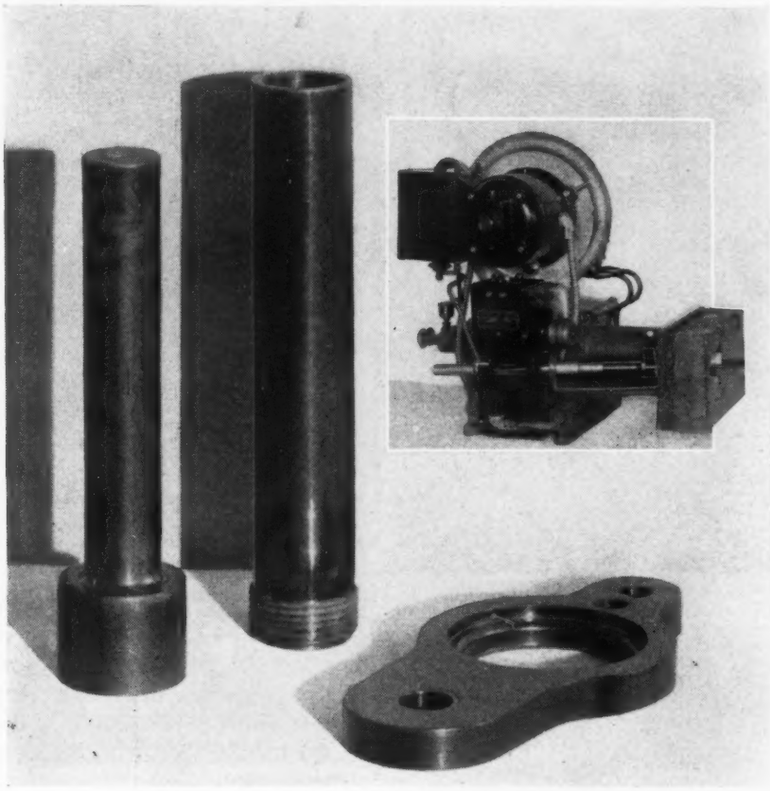

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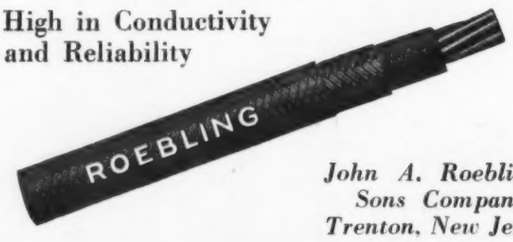

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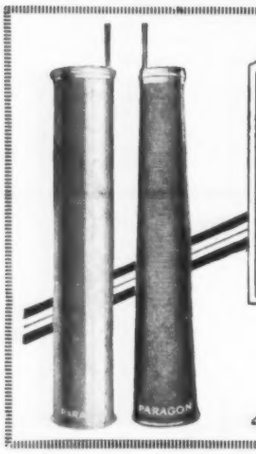

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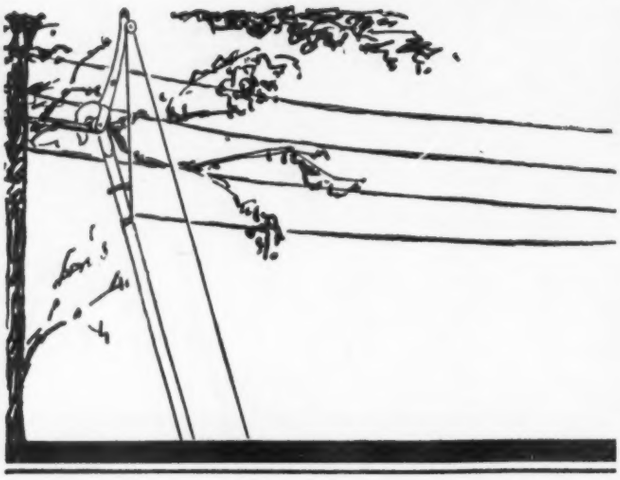

It's fast and easy work trimming trees with a Seymour Smith Pruner

Slip the cutter over a branch, give the lever cord a pull—and the branch is cut! The simplicity of this tool, its light and strong construction, ease of handling and safety features make the Seymour Smith Pruner a favorite with linemen.

Many prominent utilities have standardized on Seymour Smith Pruners for their many advantages in clearing the lines.

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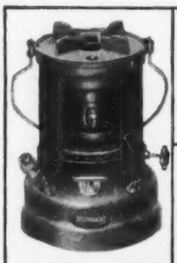
WALL "DREADNAUGHT" BLOW TORCHES and FURNACES



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Built to meet every requirement of the central station—rugged in construction, designed to withstand roughest usage, delivering maximum heat for long periods of time and operating in windiest weather. Also brazed steel double-jacketed compound kettles. Write about the DREADNAUGHT line.

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K-P-F high-tension disconnecting switches incorporate ruggedness with a minimum of parts. They are installed with less labor and material.

K-P-F ELECTRIC CO.
855 Howard St., San Francisco, Cal.

Switches—Arresters—Fuses—Sub-Station Equipment

HI-VOLTAGE Equipment Company

Cleveland

OFFICE AND FACTORY 3005 CROTON AVENUE

Non-Rusting Ground Rods Wire Strand

"COPPERWELD"

COPPERWELD STEEL CO., GLASSPORT, PENNA.

Made by the Molten Welding Process

CURVED

Patented No. 1294105

MORE WORK MADE POSSIBLE !

OBVIOUSLY, if fatigue is less, it is possible to accomplish more work in the same time. The *curved* fingers of Wilson Linemen's Gloves eliminate unnecessary opening and closing of the hand, reducing fatigue, More work is made possible.

This simple improvement, together with great dielectric strength, flexibility and safety, accounts for the great popularity of Wilson Linemen's Gloves.

Write for details and prices.

SOLE MANUFACTURERS

THE WILSON RUBBER CO.

CANTON, OHIO

"Specialists in Rubber Gloves and the World's Largest Manufacturers"

Tough and Strong Easy to use

MASTER

SHOVELS and SPOONS

(with Alloy Steel Blades)

These two styles give users a type for every heavy duty need.

Handles of second growth Northern White Ash and straps electrically seam welded to blade, for your heavy duty digging needs. Good appearing and long lasting.

Write for complete details.

OSHKOSH

POLE LINE CONSTRUCTION TOOLS

Leach Company

Dept. E

Oshkosh, Wisconsin

LEFT—Straight shovel, front view. RIGHT — Straight shovel, side view.

LEFT — Western pattern spoon. RIGHT — Eastern pattern spoon.

Now a New—

TROUBLE PROOF LITE for TROUBLE SHOOTING

NO MOVING PARTS TO GET OUT OF ORDER!

NEW TYPE BB 300,000 CP. BEAM ONE MILE RANGE For High Tension Lines

NEW TYPE BF FLOODLIGHT Illuminates 30,000 Sq.ft. at 50 Feet For Manholes

BEAMOLITE

TROUBLE SHOOTER

All metal parts are made of brass and bronze composition. Reflector and handle can be quickly detached and used in the hand for repair work and trouble hunting. The BEAMOLITE will "stay put" in any position. Both frictional joints can be quickly adjusted to any tension with a coin.

300,000

CANDLE POWER IN YOUR HAND

Projects Beam One Mile

THE NEW PORTALITE

Weighs only 13 pounds

A portable electric searchlight—the most powerful obtainable for its weight—that will make night inspections and emergency repairs on overhead cross country high tension lines as safe as in daylight.

Both Beam and Flood type will burn from 2½ to 3½ hours or from 5 to 7 hours with smaller-size bulb. Equipped with special non-spillable 15 ampere hour capacity storage battery, and adjustable position lite bracket. Flood type, for manhole and ditch work, and for emergency station work will brilliantly illuminate 30,000 square feet at a distance of only 50 feet.

THE PORTALITE COMPANY

BOW AND ARROW ST., CAMBRIDGE, MASS.

RELAYS
DUNCO

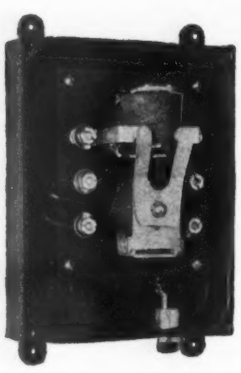
RELAY SWITCHES
. . . *for every purpose*

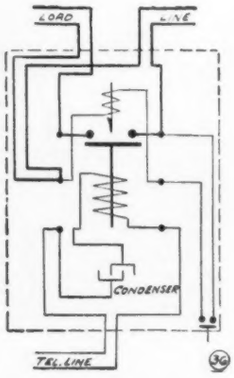
The type of relay you select should be that which *best meets your particular requirements.*

We make a wide range of standard relays . . . and if one of these won't answer we'll build a "special" that you know will do the job. Send for the complete catalog of standard relays.

"Dunco means Dependability"

STRUTHERS DUNN, INC.
142 No. Juniper St.
PHILADELPHIA, PA.



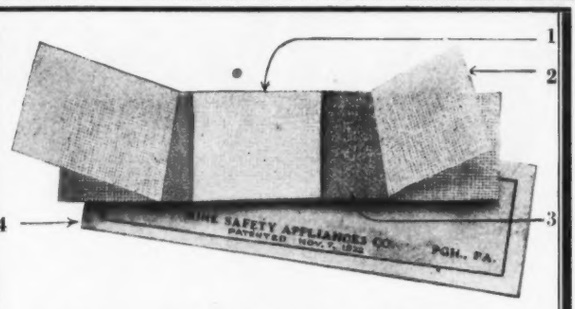


Type RS-3

TELEPHONE RINGING OF AUXILIARY SIGNALS; POLICE, TAXICAB, ETC.

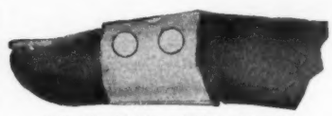
Set is complete with Relay, Condenser and Resetting Push Button. Mounted in Weatherproof Cast-Iron Housing.

See the catalog . . . page 12 . . . for complete description and price.



M-S-A MERCURO-COMPRESS
The Ideal Finger Dressing

So inexpensive that you cannot afford to be without it . . . so easily applied that the minor injury will no longer be neglected. To use: Remove Covering (2) and place Pad (1), which is medicated with H.W.D. Mercurochrome, over wound. Adhesive Tape (3) holds Pad in place. Each Dressing is enclosed in a Sanitary Glassine Envelope (4) with instructions for use.



Air Circulation Holes Permit Rapid Healing

Cartons of 150
$1.80 per Carton
F.O.B. Pgh., Pa.

Specify
FA-2133

Mine Safety Appliances Co.
Braddock, Thomas and Meade, Pittsburgh, Pa.
"Everything for Mine and Industrial Safety"

TIME SWITCHES

for control of consumption of hot water storage heaters as to peak and off-peak hours in conjunction with the thermostatic control of the hot water heater.

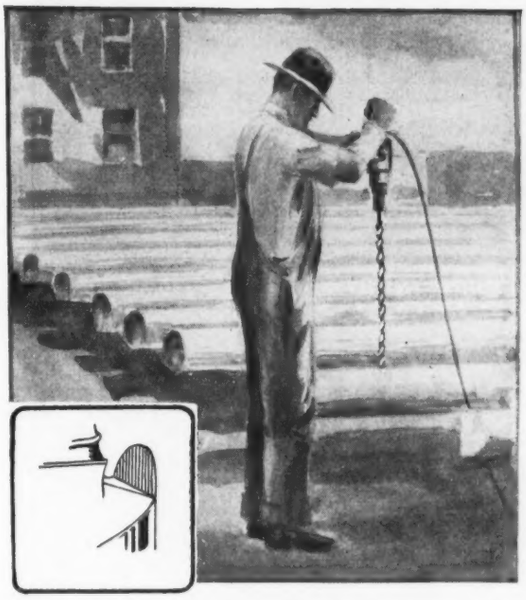
Two Circuit Time Switches

for White Way lighting control.

LANDIS & GYR, Inc.
Herbert Nehls V. P. & G. M.
104 Fifth Ave., New York

DETROIT ELECTRIC FURNACES
will
Build Power Business
for
THE CENTRAL STATION
Let us help increase your revenue
Detroit Electric Furnace Co.
825 W. Elizabeth St., DETROIT

RUGGED DISC INSULATORS
PROTECT WITH JD *TO A GREATER DEGREE.*
JEFFERY-DEWITT INSULATOR CO. KENOVA, W. VA. U.S.A.
THICKER PORCELAIN FOR POWER TRANSMISSION SERVICE.



Notice the Spur — The Spur must balance with the cutter for best results.

SNELL BITS

for High-Speed Electric Drills

Look to the Cutting Edge—On the design and tempering of this vital part depends easy cutting and long life.

The Screw determines the speed and must harmonize with the pitch of the cutter.

Study the Throat—A correctly designed Throat makes boring easier.

Strong, stiff bits designed specially for the high speeds of modern electric drills. You can't drive them too fast—you can't drive them too hard—they bite right through knots and hard wood without bending. Every Snell Bit is made of special analysis steel, and is tested in hard wood before shipping. Every maintenance truck should have a complete set. In all sizes and types for pole drilling.

Same size and type of Bits for Hand Boring.

Send for Folders showing all types and sizes of Snell Bits. *Samples and prices on request.*

No. 661 No. 812

SNELL MFG. CO.

Fiskdale, Mass.

Sales Representatives

John H. Graham & Company, Inc.

113 Chambers Street

New York City

Accurate Knowledge

of the Tension in conductors or guys

Without the necessity of cutting or dead-ending the wire. *Just clamp it on and read the tension.*

Weighing but 11½ lb.—can be carried anywhere. Any tension up to 16,000 lb. on cable or wire up to ¾ in.—without guesswork can be determined instantly with

Martin-Decker

"Shunt-Type"

Tension Indicator

A Few of Many Uses

"Sag-in" transmission, distribution and trolley conductors.

Determine guy line strains on anchors.

Adjust load proportionately on two or more guys on the same pole.

Determine types of tower footings or guy anchors best suited to various soils.

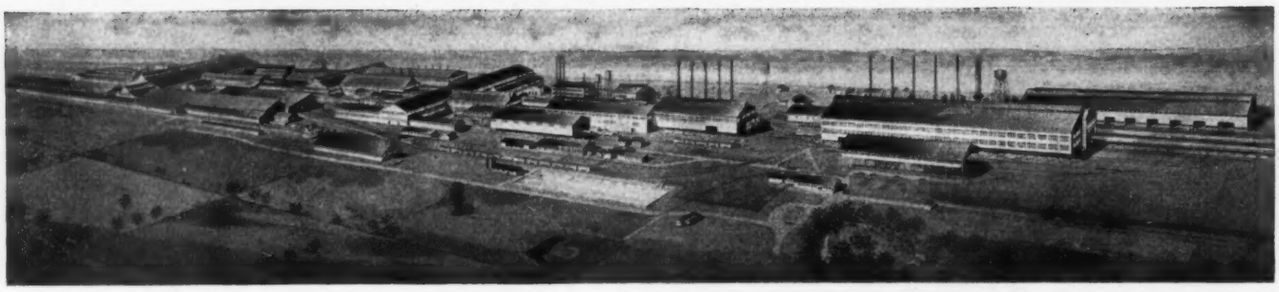
Martin-Decker

CORPORATION

3431 Cherry Avenue

LONG BEACH, CALIFORNIA

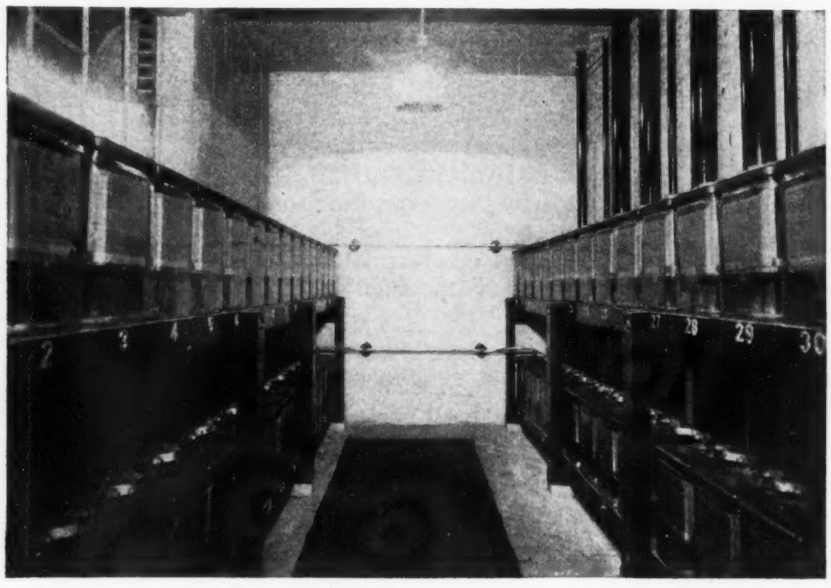
MARTIN-DECKER CORP., Long Beach, California, U. S. A.
Gentlemen: Please forward information on your Tension Indicator.
Name .....
Position .....
Address .....
City .....
State .....
E. W. 9-27-1930



HERE IS THE ASHLAND, KENTUCKY, PLANT of The American Rolling Mill Company. Electric power is protected by dependable Exide Control Bus Battery.

This Great Iron and Steel Mill has PROTECTED ELECTRIC CURRENT

The Ashland, Kentucky, plant of The American Rolling Mill Company relies on Exide Control Bus Batteries



SIXTY CELLS of long-lived, unfailing battery. This Exide, Chloride type, assures reliable control bus operation and emergency lighting in the power distributing station of the Armco Ashland Plant.

The ponderous, precise operations in a huge iron and steel mill must have reliable electric current. That's why Exide Batteries were installed.

In this immense industrial plant a 60-cell Exide Control Bus Battery with 280-ampere-hour capacity is used for dependable control bus operation and emergency lighting in the power distributing station.

In choosing Exide Batteries, The American Rolling Mill Company, like so many other industrial plants, conforms with the practice of the great majority of central stations. Practically every important light and power system in the country uses Exide Batteries. Power station engineers prefer these batteries because of their exceptionally long life and unfailing service.

We have prepared an interesting booklet which will give you full information on reliable Exide Control Bus Batteries. Write for it. No obligation. Just ask for Bulletin 203.

Exide BATTERIES

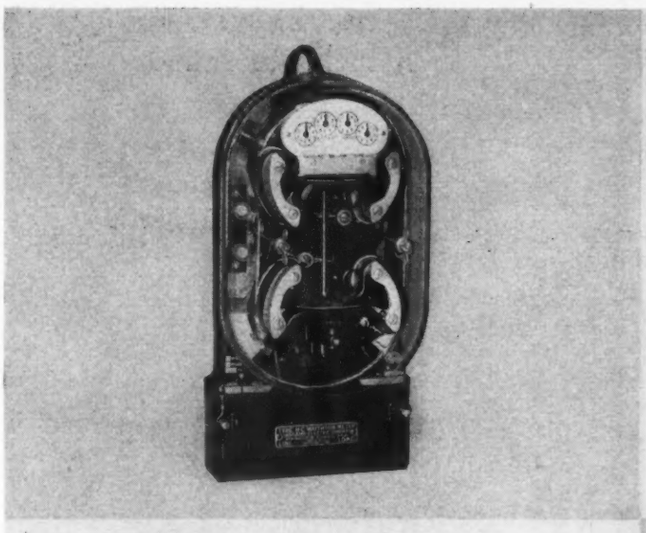
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto

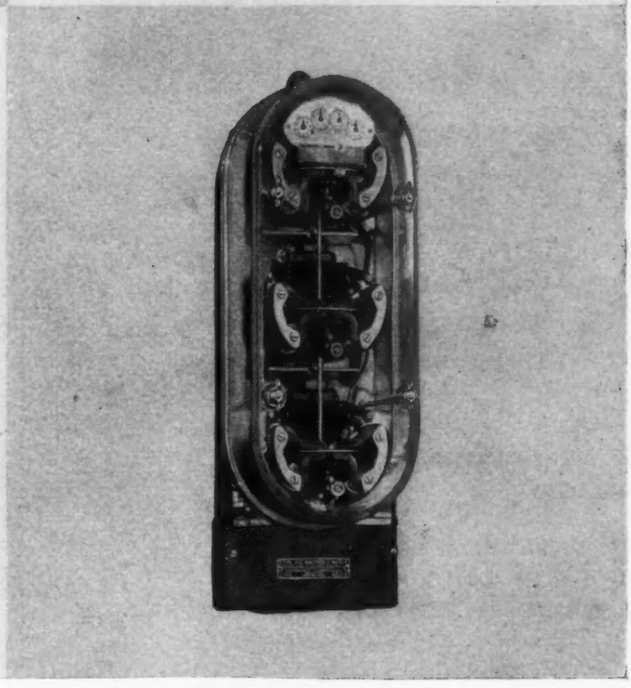
For power loads, use

SANGAMO TEMPERATURE-COMPENSATED POLYPHASE METERS



Sangamo Vertical Two-Element Polyphase Service Type Meters, used on standard three-phase three-wire and two-phase three- or four-wire installations, can be supplied either with or without pilot lamps in each potential coil circuit, as illustrated. For use with transformers, any polyphase meter can be supplied with 2½ ampere current coils.

Sangamo Vertical Three-Element Polyphase Service Type Meters measure accurately three-phase four-wire service under any condition of unbalanced load. Three-element meters can also be used to measure the combined load of three-wire three-phase and three-wire single-phase service. Pilot lamps in the potential circuits can be supplied if specified.



All Sangamo Polyphase Meters are built with standard H C temperature-compensated elements. They have bottom-connected bases and are fitted with interchangeable, removable, moulded individual terminals. A Type H B Demand Register can be supplied on any Sangamo Polyphase Meter, if specified.

SANGAMO

ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

86-8334-17

▼

Roller-Smith Announces

New Catalog No. D-48

On Switchboard Type Instruments

The New Roller-Smith Catalog No. D-48 covers the entire line of Roller-Smith Switchboard Type Instruments.

Direct Current
Alternating Current
Thermo Couple
Instrument Transformers

All sizes of instruments from the small 3½-in. up to the Illuminated Dial are included.

This Catalog is in compact and convenient form. A copy should be in the hands of every man who is interested in any way in electrical measuring instruments

Send for your copy
of New Catalog No. D-48.

Over 35 years' instrument experience in back of

ROLLER-SMITH COMPANY
Electrical Measuring and Protective Apparatus

MAIN OFFICE
237 Broadway, NEW YORK

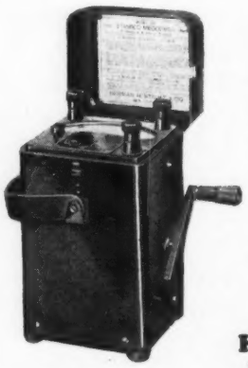
WORKS
Bethlehem, Penna.

Offices in principal cities in U. S. A. and Canada

WE EXTEND the facilities of our organization to those desiring information or reports on companies with which we are identified.

Electric Bond and Share Company

Two Rector Street New York



Model "DM" MEGOHMER pays for itself in 1 to 2 years—

You are paying for the Model "DM" Megohmer now. Why not get it? It is an invaluable "trouble-shooter" for industry. Users say it pays for itself in 2 years, on an average. Ask for Bulletin No. 170.

Herman H. Sticht & Co.
Electrical and Industrial Instruments
19 PARK ROW NEW YORK, N. Y.

An S&H Product

"Dull Knife's" redskins tasted lead from a Colt .44

Just a slice of life when Dull Knife's raiding redskins cornered Anderson Helton, cow puncher, in the vicinity of the Driscoll Brothers ranch in the Cherokee Strip. The yelling braves thought they had him, but they had not counted on his Colt .44. The bullet was quicker than the leader's sudden throw to the other side of his racing cayuse and Helton escaped.

The story of the West is full of such incidents when the crack of a Colt tamed Indians and bad men, protecting life and pushing frontier boundaries ever forward. Protecting settlers, guarding the mails and establishing law and order, Colt opened up new trails along which civilization followed.

Yet today, Colt means something more to the electrical industry. Through the manufacture of the Colt-Noark line of Safety switches and meter protection devices, the Colt organization is a part of this great industry that it has chosen to serve—offering protection for electrical equipment.

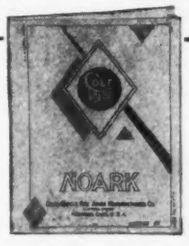
Noark, one of the oldest names in the electrical industry, has for seven years been strengthened by the manufacturing precision found throughout the great Colt plants. Colt selected Noark because the Noark line of electrical protective devices geared with specific manufacturing and engineering facilities long associated with an organization famous for its ability to develop and manufacture products of a mechanical nature.

COLT NOARK

COLT'S PATENT FIRE ARMS MFG. CO., Established 1836 — ***Electrical Division*, HARTFORD, CONN., U.S.A.** Electrical Division 1886

M-16

An inspection of Colt-Noark catalog No. 57 will reveal how thoroughly Colt is carrying on its tradition of service and protection. This catalog and an interesting publication, "The Rampant Colt" will be mailed upon request.



A Construction Service for Public Utilities

based upon "SPECIAL ATTENTION *to the* SMALLEST DETAILS"

The ability to carry through a complicated construction job with every phase of the work rigidly supervised by competent men is now offered to Utilities, Municipalities, States, etc., by the Hastings & Sanders Construction Co., Ware, Mass.

Those who have engineering plans under way requiring a general contractor, will do well to consult with us before going ahead. *We specialize in construction of transmission lines, distribution systems, outdoor substations, power houses, railroad electrification and electrical installations of all kinds.*

We have in charge of our High Tension Transmission and Distribution construction field a man who has had personal charge of some of the largest, most difficult and most important jobs ever constructed in the East.

Accordingly, we offer to Public Utilities and others a combined experience of many years, a strong construction organization of high financial standing and an organization with competent engineers and complete equipment including tools, trucks, machinery, etc.

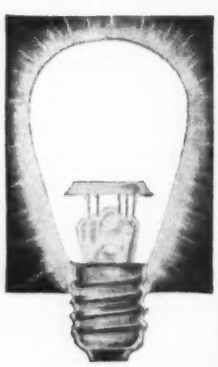
Our service includes every phase of construction and our broad experience is a guarantee that all work will be done correctly—down to the smallest detail, that it will be done on time, and that it will be right. Consult with us—no obligation.

HASTINGS & SANDERS CONSTRUCTION CO.

General Contractors, WARE, MASS.

As a night light in the home . . . *the new* 2 watt

NEON GLOW LAMP



Unique, *extremely economical,* the new 2 Watt Neon Glow Lamp has almost unlimited uses—as a night lamp in the home—a stroboscopic lamp in industry. Radiates from unbreakable metal disk instead of fragile filament. Burns thousands of hours. Fits standard socket. 110 Volts A. C. or D. C. A fast seller! Write for full details. General Electric Vapor Lamp Co., 805 Adams Street, Hoboken, New Jersey.

GENERAL ELECTRIC VAPOR LAMP COMPANY

(Formerly Cooper Hewitt Electric Company)

© G.E.V.L.Co. 461 1930

MANSFIELD

CLEAN INSIDE—Made in our own open hearth furnaces, using the latest and most progressive methods to get good clean steel.

CLEAN OUTSIDE—Rolled and treated with utmost care to obtain high quality and uniformity in all respects.

RESULTS—Better magnetic performance, best die service.

Empire Steel Corporation, Mansfield, O.

Successors to the Mansfield Sheet & Tin Plate Co.

ELECTRICAL SHEETS

High Dielectric Strength

Lavite Insulation

Great Mechanical Strength

A leader for forty years.

D. M. Steward Mfg. Co.

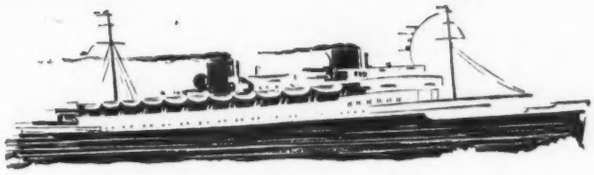
Chattanooga, Tenn.

The VIKING TOOL & MACHINE CO. INC

Designers and builders of Coil Winding Machines, Wire Measuring Machines, Revolution Counters and Stop Counters.

See our advertisement in the first issue each month.

747-65 ST. BROOKLYN, N.Y.



Again — the steam boat PROVES *itself*

123 years after the steamer first proved itself, it proves itself again. In 1807, the "Clermont" steamed 150 miles from New York to Albany in 32 hours. In March of this year, the steamer "Europa" crossed the ocean, 3640 miles, in 4 days, 17 hours, 6 minutes: Again the steam boat proves itself

— *so does the* Lincoln MAXIMUM DEMAND meter

ELEVEN years of severe usage in Canada's great electrical developments definitely proved the reliability of the Lincoln Demand Meter.

Again, this simple instrument proves itself in twenty-one months of severe usage on every variety of service in the United States.

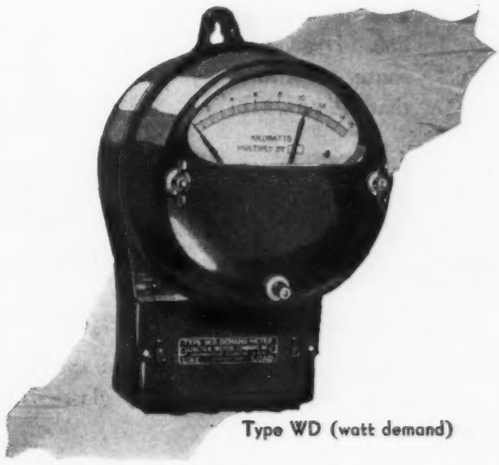
Electrical engineers have investigated the fact that no fundamental change in rate set up is necessary for the application of the Lincoln Meter. They agree that the thermal principle of operation (upon which the Lincoln Meter operates) is technically correct because it involves the same law which determines the capacity of generating and distribution equipment.

They find that the Lincoln has no rapidly rotating parts—simply a pointer and two coils which move *very slowly*. This accounts for Lincoln sustained reliability. Thus, the Lincoln Meter enables central station executives to distribute their fixed charges equitably among their customers.

A new Bulletin is awaiting your request—Bulletin No. 1A—it presents facts quickly.

Various instruments available—ampere demand, watt demand, indicating, graphic; split core transformers, and totalizers.

LINCOLN METER CO., Inc.
SPRINGFIELD, ILLINOIS
Associated Factory: Lincoln Meter Co., Limited
Toronto, Canada



Type WD (watt demand)

LINCOLN—SIMPLIFIED MEASUREMENT OF MAXIMUM DEMAND

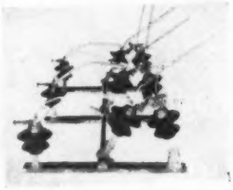
To Decrease Structure Heights

Here is a group operated, side opening, disconnect—Type TS —in which the insulator rotates to 90° opening.

BULLETIN 207-A

For Single Tilt Operation

This type S is companion to the double tilting Type R and can be used with economy on services where the high quality of the Type R is not demanded.



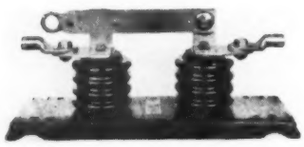
A switch that has received high praise from every quarter.

BULLETIN 206-A

For Flexibility in Cemented Cap Outdoor Type Bus Supports

A new line of interchangeable outdoor bus supports of the cemented cap type is now available. The new bulletin which supersedes No. 202 is now ready for mailing.

NEW BULLETIN 202-A



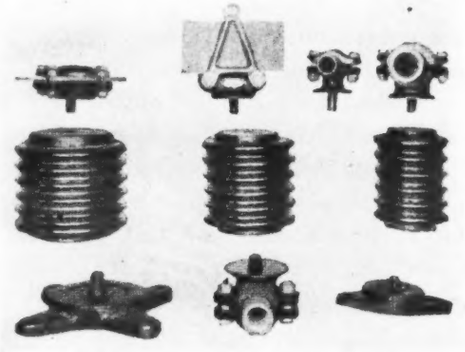
For an Unusual Indoor Disconnect

In design, construction, finish, appearance you cannot equal this Elpeco disconnect. It will meet every condition of average operation—in addition to making fast friends.

BULLETIN 101-B

For Complete Interchangeability of Indoor Bus Supports

Use the redesigned Elpeco line. It gives you every advantage you wish and many that are unusual.



A 48-page bulletin on the subject is equally as helpful to you as the product itself.

BULLETIN 102-A

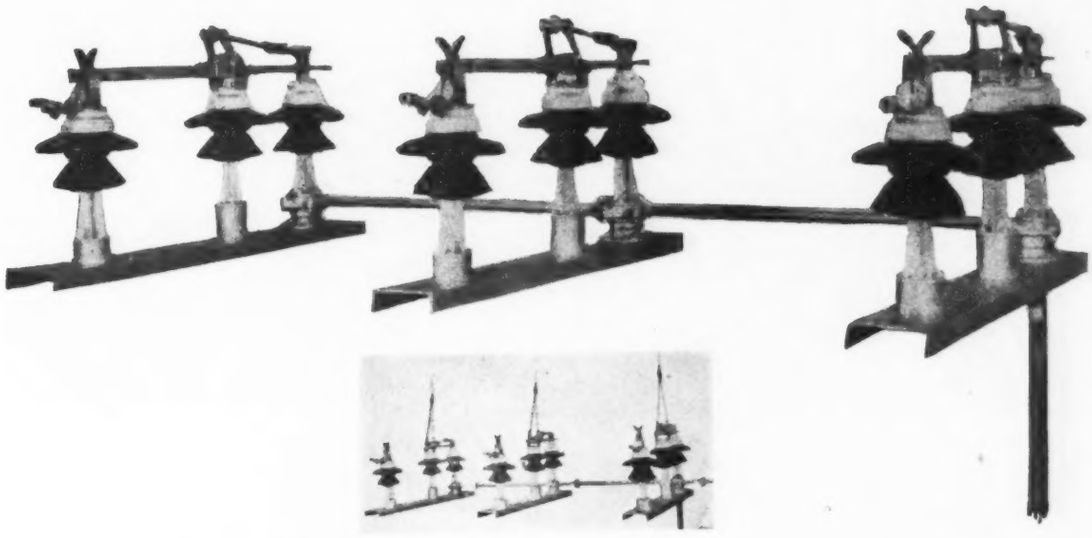
For Indicating and Color Schemes

Should you require lenses for special services—Elpeco supplies them in faceted (not lacquered) glass—Red, green, blue, yellow, crystal or opal.

Bulletin 607 describes them and signal boxes as well.

BULLETIN 607

for the good of the Service



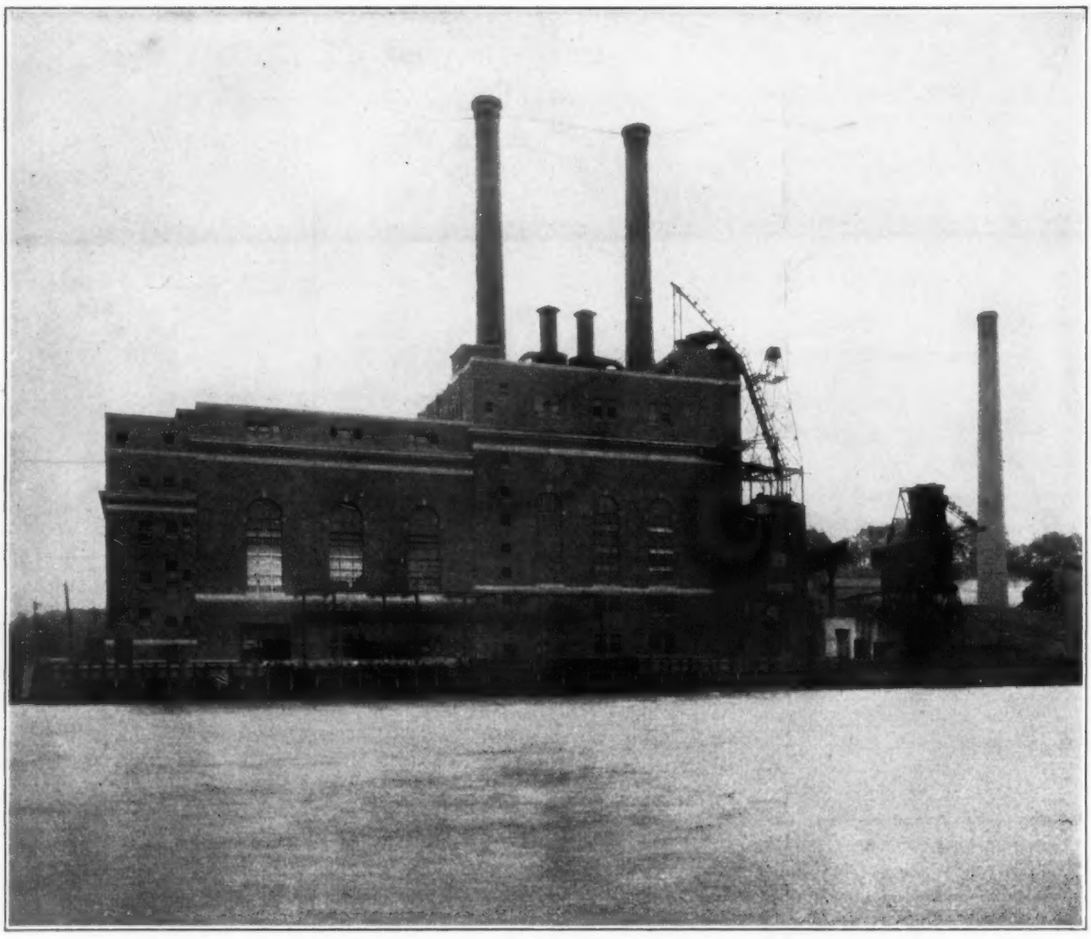
—*and now:*

Elpeco's outstanding contribution to design and construction is this No. 186 Disconnecting Switch. The large photo above shows a 44-Kv., 3-pole group operated unit in closed position. The smaller cut illustrates the same switch in open position. There are numerous operating advantages in this new design of rotating switch, for manual or motor operation, which we will gladly supply those who write us for details.

ELPEC

ELECTRIC POWER EQUIPMENT CORPORATION

412-420 NORTH EIGHTEENTH ST. PHILADELPHIA, PA.



High Boiler Efficiency Is Maintained at Glenwood Station by Smoot Control of Combustion

Glenwood Station of the Long Island Lighting Company, E. L. Phillips & Co., designers and constructors, serves Nassau County adjacent to New York City. There are four boilers operated with the storage system of pulverized coal firing.

The Smoot Control System at Glenwood is of the latest design of centralized mechanical control and maintains high boiler efficiency at all loads by

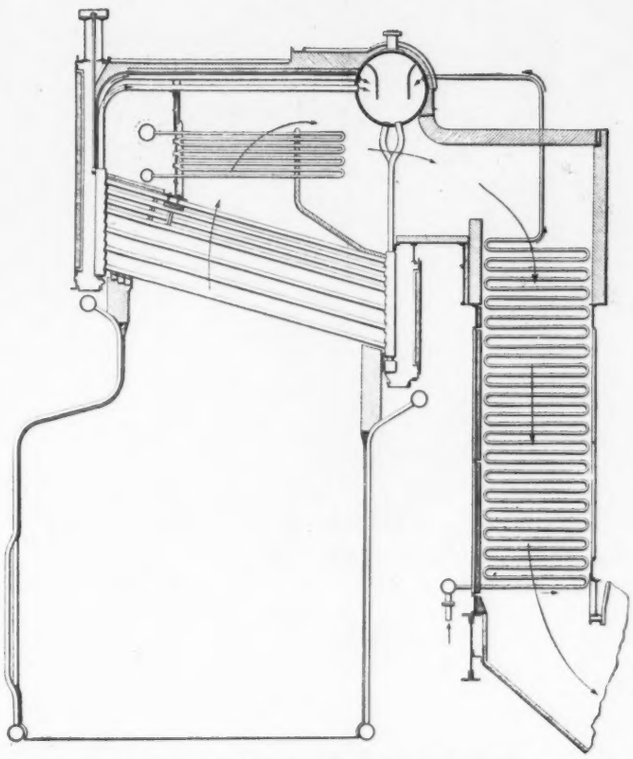
1. Maintaining constant steam header pressure.
2. Maintaining the coal feed and air supply of each boiler always in proportion to its load with no lag.
3. Maintaining constant draft in each furnace.
4. Allowing the operator to divide the station load between the boilers in any way and to operate them at either constant rating or variable rating.
5. Regulating the feedwater excess pressure in proportion to the boiler load.
6. Controlling the boiler feed pumps.

Smoot Engineering Corp., 136 Liberty St., New York

SMOOT CONTROL

The Two-Stage Boiler

A Typical Product of Babcock & Wilcox Research



The Babcock & Wilcox Two-Stage Boiler—Patented

In The Two-Stage Boiler, part of the water is evaporated in the forced flow stage and evaporation of the remaining water is completed in a natural circulation stage, thus combining in one unit the advantages of natural circulation in high gas temperature regions with those of the forced flow series boiler where temperatures are low. The result is a unit which is compact, efficient and which can be built for a lower investment in boiler and in building, especially where steam pressures are high.

The Two-Stage Boiler is a typical Babcock & Wilcox product, typical because it has been thoroughly proven by test and service and it is at the same time in keeping with power plant requirements of today —and tomorrow.

The natural circulation stage is a Babcock & Wilcox boiler with a background of over sixty years of successful operation. The forced flow steaming stage is the result of more than fourteen years of research on high pressure boilers.

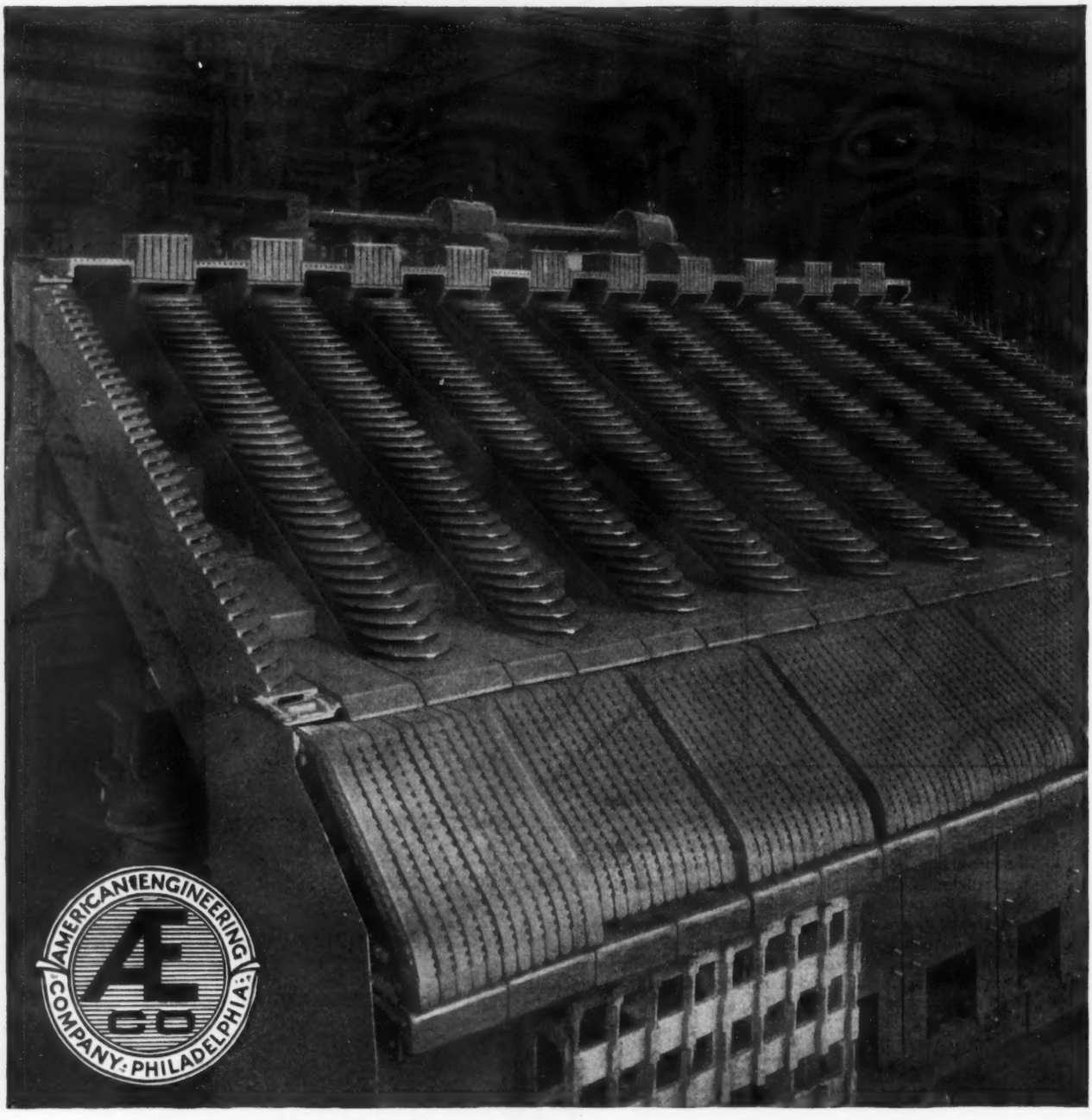
THE

BABCOCK & WILCOX COMPANY

85 LIBERTY ST. NEW YORK, N.Y.

G-37

. . . Consolidated Gas Buys More



Taylor Stoker for Westport Station of the Consolidated Gas Company, Baltimore

AMERICAN

AMERICAN ENGINEERING COMPANY, ARAMINGO AVENUE, PHILADELPHIA, PA.

Company, Baltimore Taylor Stokers

. . . and now WESTPORT

Taylor Stokers and A-E-CO Furnace Armor (water walls) have been ordered by the Consolidated Gas Company of Baltimore for modernizing their Westport Station.

This order follows a recent order for an additional Taylor Stoker and water walls to be installed at the Terminal Heating and Freezing plant of the same company.

The Taylor Stoker installed at the Terminal Heating plant in the Fall of 1928 was put on the line in December of that year, after being installed in record time, and was never taken off until the close of the heating season, four months later. During the first season's run, 9,780,000 tons of coal were burned, with no maintenance whatever on the stoker. During the 1929-1930 heating season, the boiler went on the line the latter part of October and was not taken off until the latter part of April, after burning 12,457 tons of coal.

Stoker maintenance for the entire two seasons, for labor and parts, amounted to only 1.7 cents per ton of coal burned.

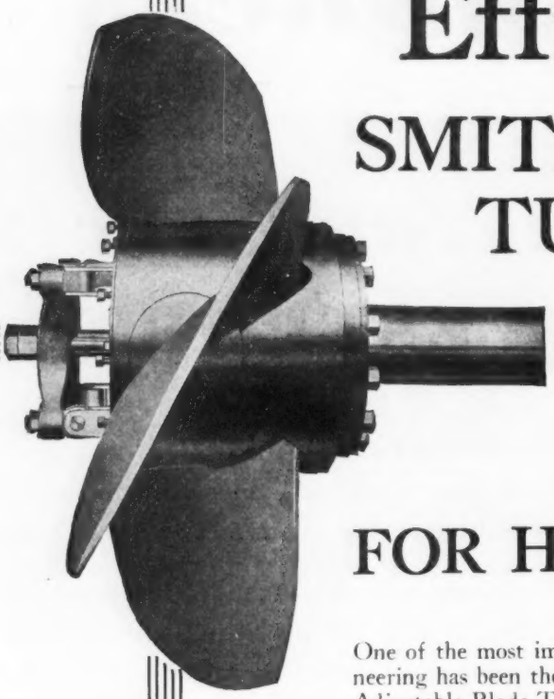
Write for "Burning Coal the Modern Way" . . . a book that should be in the hands of every executive responsible for obtaining steam at lowest cost.

ENGINEERING

IN CANADA: AFFILIATED ENGINEERING COMPANIES, LTD., MONTREAL, P. Q.

High Part Load Efficiency!

SMITH-KAPLAN TURBINE



Turbine with Blades in Open Position

FOR HEADS UP TO 66'

One of the most important advances in the field of Hydraulic Engineering has been the introduction of the Smith-Kaplan Automatically Adjustable Blade Turbine . . . In a recent advertisement we showed how a Smith-Kaplan turbine installed at York Haven developed nearly twice the capacity of the original unit it replaced . . . surely a convincing example of the high efficiency of this runner.

The automatic adjustment of the blades maintains the proper conditions of flow through the runner for all variations of load and head, thus developing the maximum efficiency and power at all times. The large overload capacity characteristic of this turbine, in addition to providing for carrying surplus load, permits the carrying of normal full load under reduced heads due to floods, etc. The high specific speed permits direct connections to smaller high speed generators, thus reducing the investment in equipment required to develop low head water power sites.

The Smith-Kaplan Adjustable Blade Turbine can be safely used for any development where fixed blade turbines could be installed and will show greatly increased yearly output over such a fixed blade installation.

Write for Bulletin 123.

We are the sole licensee under the Kaplan Patents in the United States and in Canada.

S. MORGAN SMITH CO. HYDRAULIC TURBINES

York, Penna., U. S. A.

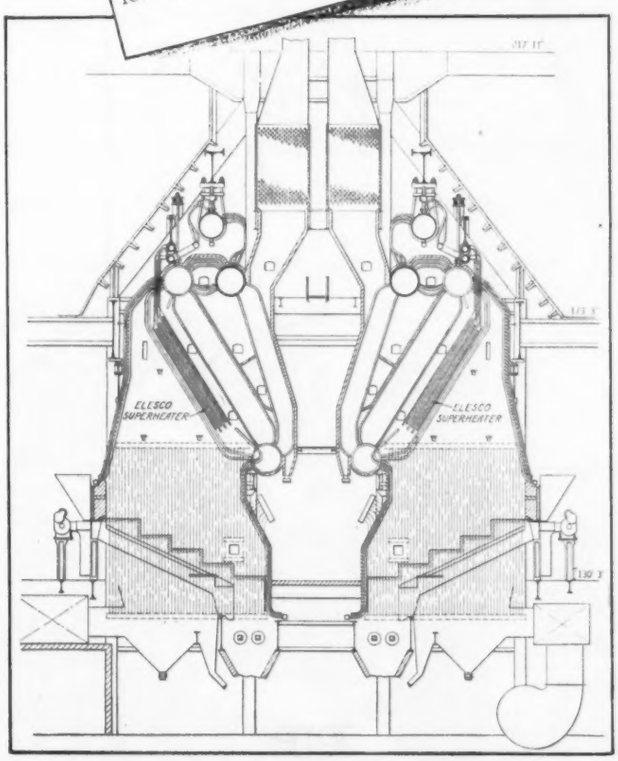
Boston—Chicago—Salt Lake City—Denver—Portland, Ore.—San Francisco
Associated Company—S. Morgan Smith—Inglis Co., Ltd., Toronto, Canada

From Electrical World
Aug. 30, 1930 issue.

Combustion Engineering Gets Boiler Contract

COMBUSTION ENGINEERING CORPORATION announces the receipt of a contract from the Brooklyn Edison Company for eight boilers and accessories, to be installed in the Hudson Avenue generating station. This contract amounts to more than $2,000,000. In addition to the boilers, the contract includes complete water-cooled furnaces, boiler settings and steel work, and economizers, all of which equipment is to be designed, manufactured and installed by the corporation. The boilers are of the Combustion Engineering bent-tube type, containing 24,450 sq. ft. of heating surface per boiler and equipped with "Elesco" superheaters. The design pressure is 500 lb. per square inch, with an operating pressure of 440 lb. at the superheater outlet. All eight units are of identical design and are arranged for stoker firing. Each unit is designed for a maximum steam production of 530,000 lb. per hour. Four units are scheduled to be in operation by August, 1931, and the remaining four by January, 1932.

To amplify the news:



THESE Elesco superheaters will raise the temperature of the steam approximately 300 deg. F., giving a final temperature of 750 deg. F. for use in the turbines.

They will be of the intertube type, an exclusive development of The Superheater Company.

In this type, as shown in the illustration, seamless multiple-loop, single-pass units, through which the steam passes, extend down into the boiler tube banks, next to the furnace.

This makes possible the attainment of high uniform steam temperature, as required to operate large turbines at a high degree of efficiency.

THE SUPERHEATER COMPANY

60 East 42nd Street, NEW YORK

Peoples Gas Building
CHICAGO

ELESCO

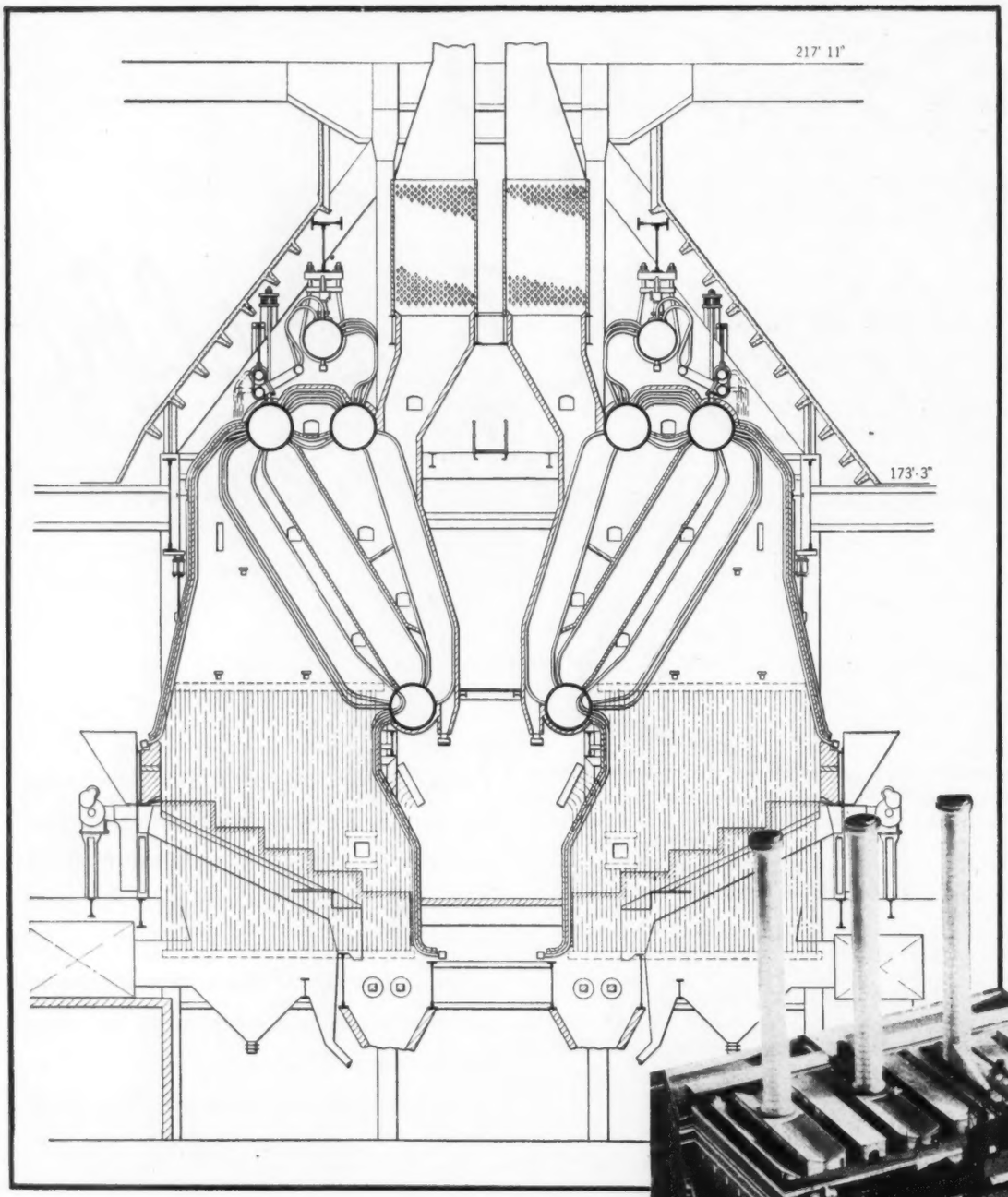
Union Trust Building
PITTSBURGH

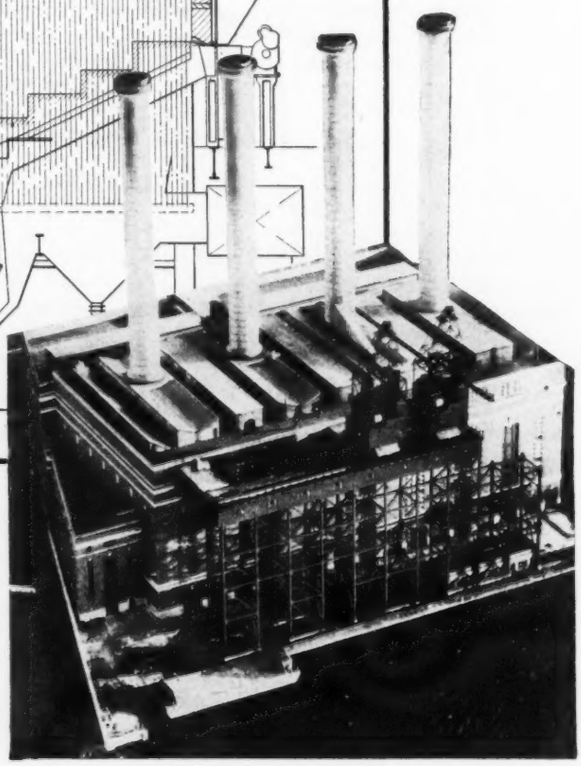
CANADA: The Superheater Company, Limited, Montreal

Represented in

BIRMINGHAM CHARLOTTE DENVER HOUSTON KANSAS CITY MEMPHIS NEW ORLEANS SAN FRANCISCO TACOMA

A-500





Sectional side elevation of two of the eight Combustion Engineering Units to be installed in the Hudson Avenue Station of the Brooklyn Edison Company

COMBUSTION

Eight Combustion Engineering Boilers to increase Hudson Avenue Station Steam Output by over 4,000,000 lb. per hr.

The new addition to the Hudson Avenue Station of the Brooklyn Edison Company is designed to provide a maximum of water heating surface and furnace volume within the building space available.

To accomplish this, eight Combustion Engineering Bent Tube type boilers, and eight bare tube furnaces, of the C-E Fin type, comprise the steam generating surface. Each of the eight units is equipped with a C-E Fin Tube Return Bend Economizer.

•

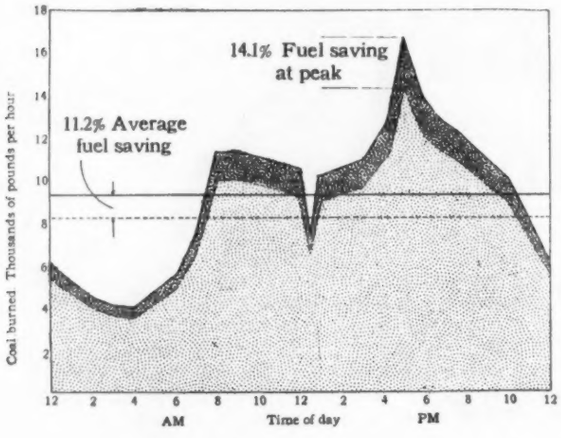
COMBUSTION ENGINEERING CORPORATION
200 MADISON AVENUE NEW YORK, N. Y.

BOILERS - AIR PREHEATERS - STOKERS - PULVERIZED FUEL EQUIPMENT - WATER-COOLED FURNACES

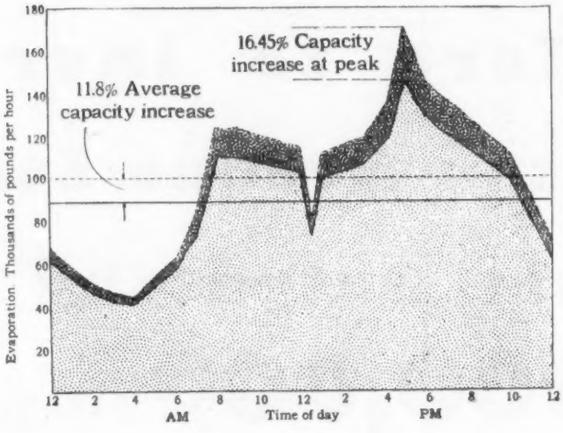
ENGINEERING

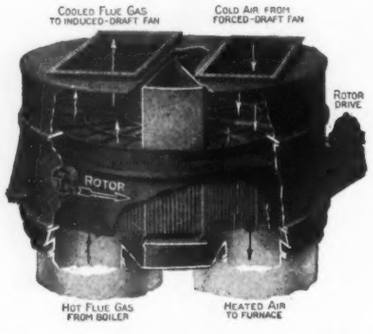
Which can you use to best advantage?

10 to 14% fuel saving at the same output.



10 to 15% more steaming capacity without fuel rate increase.





Type CANX, for use with independent forced-draft and induced-draft fans. Operated with rack-and-pinion drive, and has a center thrust bearing in the cold air side of the top housing. For boiler units of 1000 hp. and over.

Type CAN Ljungström Air Preheater with Integral Forced-draft and Induced-draft fans.

The scroll fan housings in connection with axial fan wheels greatly increase fan capacity and decrease operating power requirements.

Built also in vertical and horizontal types for use with independent forced-draft and induced-draft fans. The horizontal type handles flue gas temperatures up to 1600 deg. fahr.

WASTE heat recovery and preheated combustion air offer you either or a highly desirable combination of both—but only if you choose the Ljungström Air Preheater are you assured of maximum benefits upon terms that will repay the cost of the whole preheater installation in from one to two years, and thereafter pay a higher net cash money return on the investment than obtainable from any other major apparatus in the boiler room.

The high net money return and continued satisfactory performance, we are prepared to guarantee in any plant operating at high use factor or heavily loaded throughout working hours.

Remember that waste heat utilization by means of a Ljungström Preheater effects substantial fuel saving every working minute, and as heat losses are ordinarily greatest and recovery can be highest during the periods of greatest boiler forcing, *the greatest capacity increase comes when most needed.* If your plant is overloaded, equipping with Ljungström Preheaters costs less than adding more boilers, but solves the problem just as surely.

Only with the Ljungström continuous regenerative counterflow principle and Ljungström quick-acting heating surface is 70% heat recovery possible from preheater equipment of minimum size, weight and minimum initial and installation costs, so the Ljungström Preheater should have first consideration.

You overlook an opportunity if you fail to have our Engineers submit figures and guarantees. At least write for our new catalog.

Over 8,000,000 square feet of Ljungström Regenerative Heating Surface in service in the U. S. A. and over twice as many units were installed in 1929 as in 1928.

THE AIR PREHEATER CORPORATION

40 E. 34th Street, New York

Works: Wellsville, N. Y.; Agents in

Boston	**Charlotte**	**Cleveland**	**New Orleans**	**Kansas City**	**Los Angeles**
Buffalo	**Detroit**	**Minneapolis**	**Pittsburgh**	**Houston**	**San Francisco**
Chicago	**Philadelphia**	**St. Louis**	**Cincinnati**	**Denver**	**Tacoma**

Canada: Lammers & Maase, Ltd. Montreal and Vancouver

Ljungström AIR PREHEATER

REG. U.S. PAT. OFF.

CONTINUOUS REGENERATIVE COUNTERFLOW

There's one right way

TO CHOOSE CONDENSING EQUIPMENT

When a steam condensing unit is built today, it should be the result of a thorough study of conditions by a competent engineer and close co-operation of the buyer.

By giving plant conditions this necessary thought, C. H. WHEELER has gained a reputation during nearly half a century of solving condensing problems to the satisfaction of the plant owner.

To assist you C. H. WHEELER engineers will select the condenser best suited to your requirements.

C. H. Wheeler Manufacturing Co.
19th St., Sedgley and Lehigh Avenues
PHILADELPHIA, PA.
Offices in principal cities

C. H. WHEELER OF PHILADELPHIA

WE MANUFACTURE

Surface, Jet and Barometric Condensers;

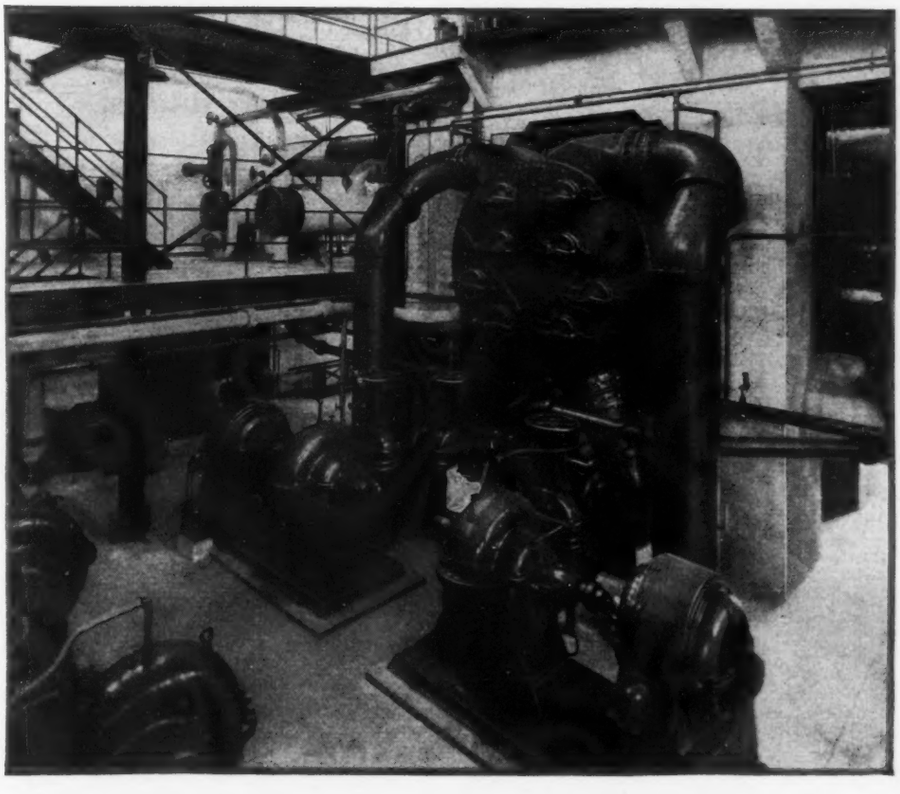
Leach Fracto Control Condensers;

Oil Vapor Condensers;

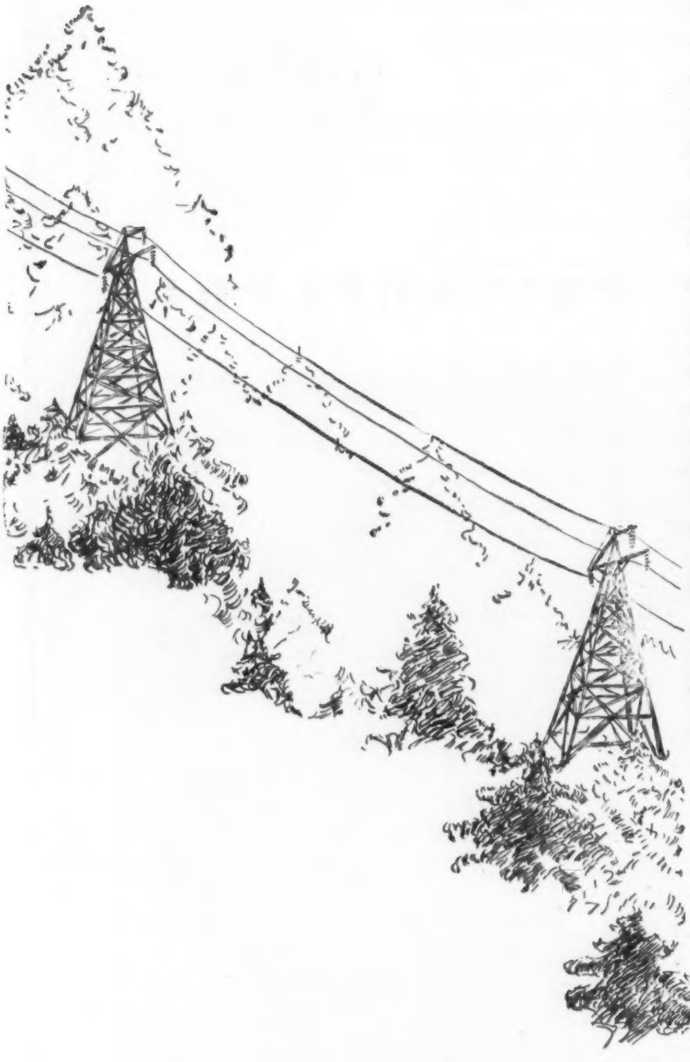
Heat Exchangers;

Ejector Type Air Pumps for vacua up to 29.95 inches;

Forced and Natural Draft Cooling Towers.



NIAGARA FALLS POWER SUPPLEMENTED BY STEAM STATIONS



OF the total electrical energy—six and a half billion kilowatt-hours — distributed by the Niagara Hudson System in 1929, 71.3 per cent was produced by hydro-electric plants, 14.5 per cent was purchased from other systems and 14.2 per cent was generated by steam power stations.

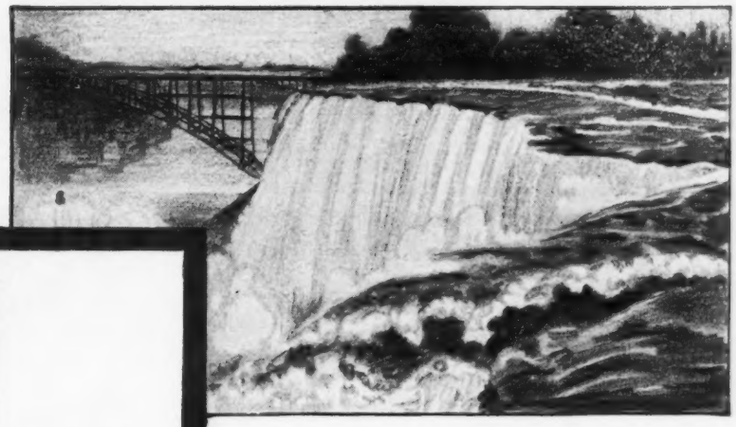
The steam plants must handle base loads at high efficiency whenever the hydro-electric system conditions demand, and also supply dependable standby service and low-load factor operation at other times.

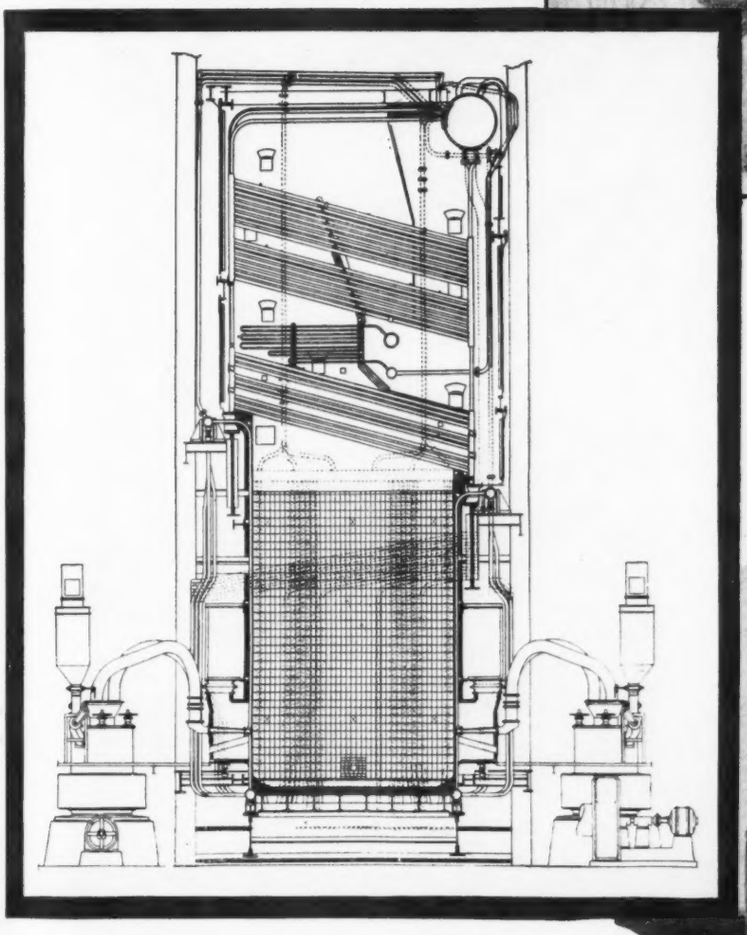
The largest steam station on the Niagara Hudson System is the Charles R. Huntley Station No. 1, of the Buffalo General Electric Company. At this plant, 10 boiler units equipped with Bailey Water-Cooled Slag-Tap Furnaces are fired by the Fuller Lehigh Direct-Fired System of Pulverized-Coal-Firing.

Standby and peak-load service is a severe test of power plant apparatus. However, the Fuller Lehigh Equipment is specially designed for such service. Base loads are handled efficiently, and sudden and abnormal steam demands are met satisfactorily. The equipment is highly flexible, permitting load to be picked up promptly in an emergency. And boilers—banked for many hours—are put on the line quickly because relatively little heat is lost during the shut-down period. Boilers — out of service—can be brought up in minimum time.

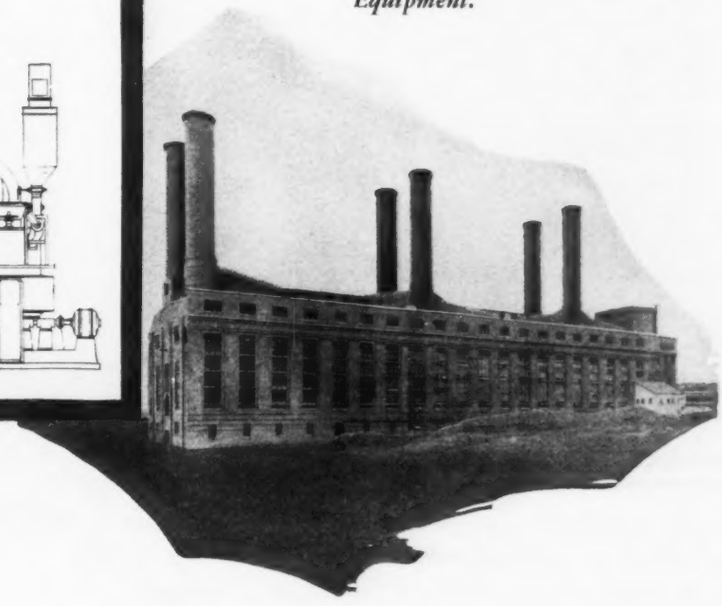
As a result of the satisfactory operation of the Fuller Lehigh Equipment and Bailey Furnaces at Station No. 1, similar apparatus is being installed at the Charles R. Huntley Station No. 2—under construction.

FULLER LEHIGH COMPANY
A Babcock & Wilcox Organization
FULLERTON, PENNA.

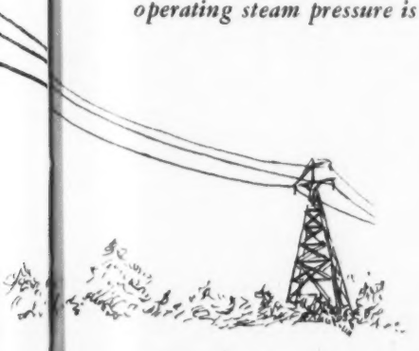




The Charles R. Huntley Station No. 1 in which 10 Babcock and Wilcox Boilers are fired by Fuller Lehigh Pulverized-Coal-Firing Equipment.



Arrangement of boiler, direct-fired pulverized-coal-firing equipment, and slag-tap furnace at the Charles R. Huntley Station No. 2. The boiler has a maximum capacity of 560,000 pounds of steam per hour. The operating steam pressure is 500 lb. per sq. in.



FULLER LEHIGH

PULVERIZED-COAL EQUIPMENT
WATER-COOLED FURNACE WALLS

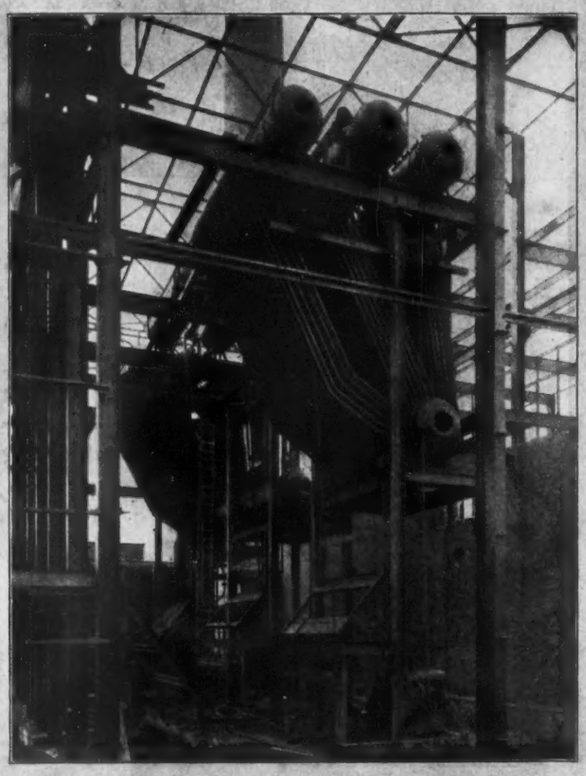
139-T

A list of Edge Moor Boiler users would read like a "Who's Who" of leading plants in more than 50 different branches of industry.

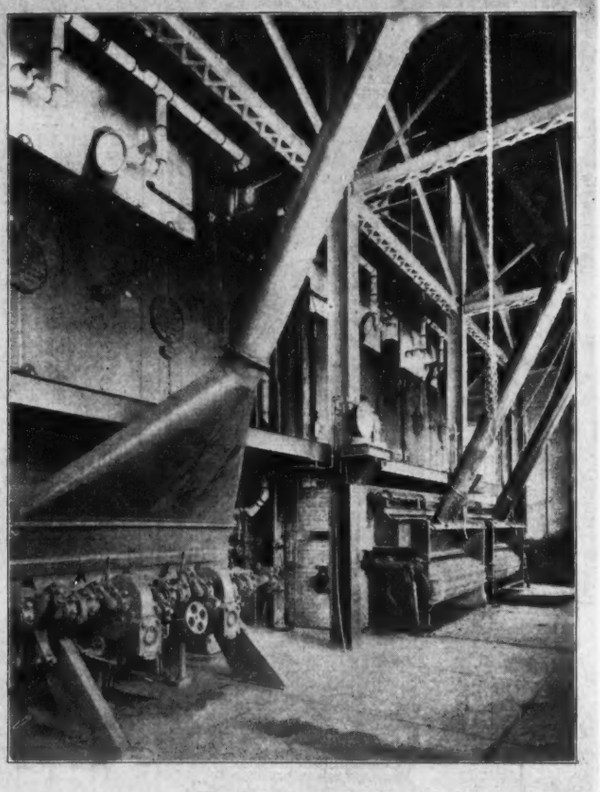
One reason for this wide-spread popularity is the ADAPTABILITY of the Edge Moor line of Boilers to the steam requirements of practically any size or type of plant.

Another reason is their EFFICIENCY revealed by actual service records which show many well balanced plants obtaining combined efficiencies of

FROM CIGARETTES TO CENTRAL STATIONS



Three Edge Moor 4-Drum Bent Tube Boilers, totaling 2085 h.p., built to operate at 400 lbs. pressure, are installed at the Bedford Pulp & Paper Company plant, Big Island, Va. They are equipped with Foster Superheaters and Diamond Soot Blowers.



The Laclede Gas Light Co., St. Louis, has purchased Edge Moor Boilers 9 times during the past 25 years . . . a total of 15 boilers aggregating 7376 h. p. Above are three 516 h. p. Edge Moor Longitudinal Drum Boilers, installed in one of this company's plants.

more than 80% — sustained capacities in excess of 300% of nominal rating.

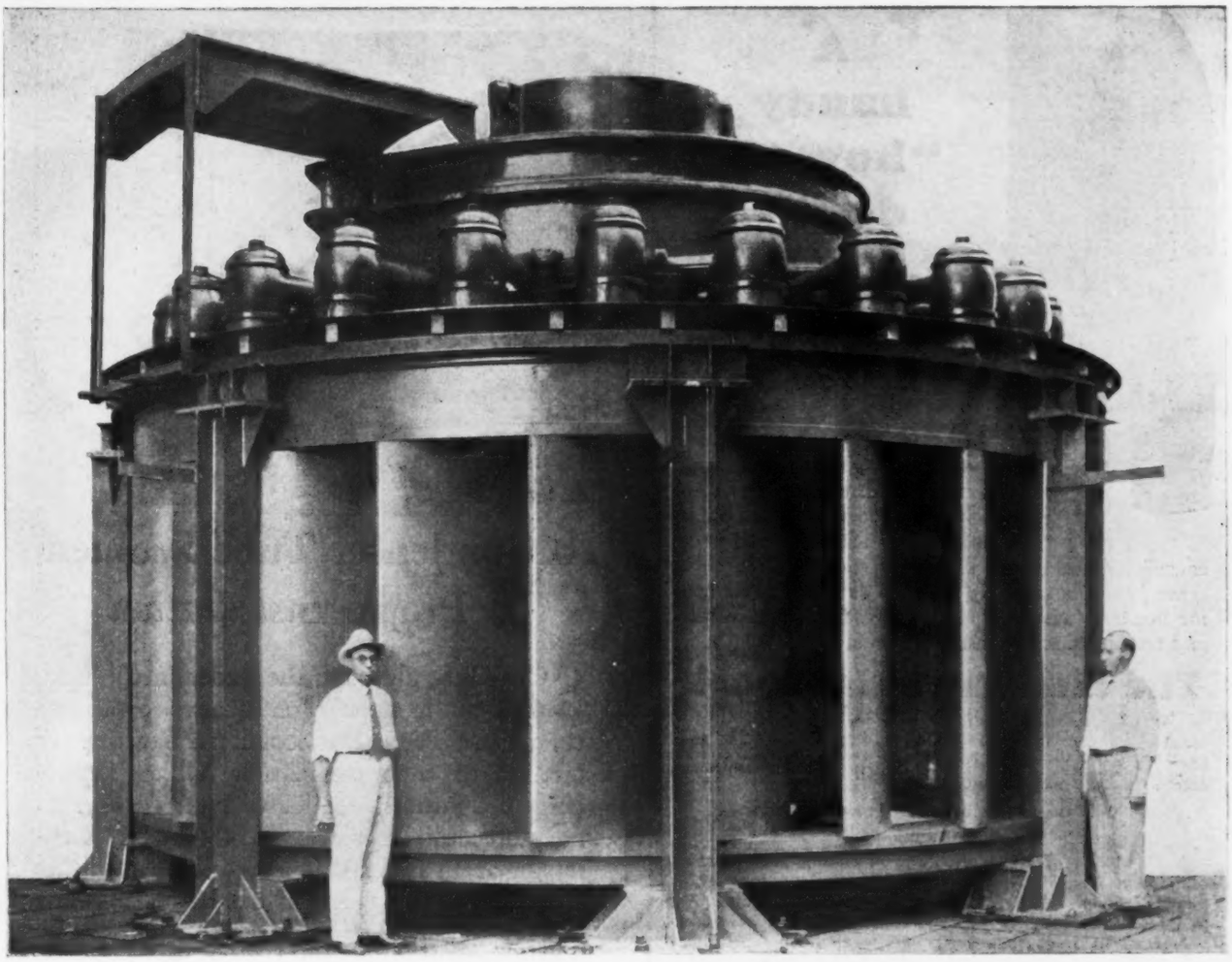
Still another reason is their ECONOMY. Economy of maintenance and operation and the long life of Edge Moor Boilers mean the extension of a profitable investment over a broad span of years.

When you spend — spend to save — to save fuel, maintenance expense, shut-down time. Investigate the type of Edge Moor Boiler best suited to your needs. Details of design and construction will be sent on request.

EDGE MOOR IRON COMPANY
Established 1868
Edge Moor, Delaware
NEW YORK CHICAGO ST. PAUL CHARLOTTE LOS ANGELES

EDGE MOOR Water Tube BOILERS

STRAIGHT AND BENT TUBE TYPES—WATER WALLS—AIR PREHEATERS

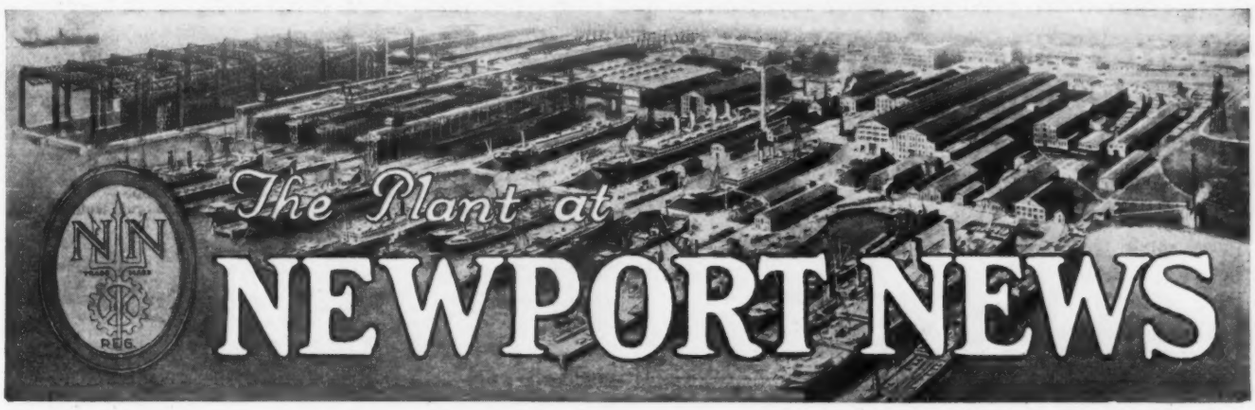


SHOP ASSEMBLY OF
57000 HORSEPOWER 81 FOOT HEAD TURBINE
SPIER FALLS DEVELOPMENT
NEW YORK POWER & LIGHT CORPORATION

Designed and built by
Hydro-Electric Division

Newport News Shipbuilding & Dry Dock Co.

Newport News, Virginia — New York, 233 Broadway



A handy "how-to-do-it" book for the Lineman

THIS practical, pocket-size manual gives you quick, accurate information on every phase of line wiring and maintenance. Packed from cover-to-cover with methods, kinks, short-cuts, tables, diagrams, and photographs, it is the daily reference book for linemen, wiremen, electricians, maintenance men, and transmission foremen everywhere.

The Lineman's Handbook

By EDWIN KURTZ

Member A.I.E.E.; Professor of Electrical Engineering and Head of Department, Oklahoma Agricultural and Mechanical College; formerly Member of the Educational Department, Milwaukee Electric Railway and Light Company.

542 pages—semi-flexible—pocket size, 603 illustrations, $4.00

DO YOU WANT the latest data on testing, leak-locating, trouble-shooting? Do you want to know anything about guy materials? This book discusses them thoroughly. Are you interested in quick, workmanlike tower and pole erections? This work tells you step-by-step how experienced foremen go about this work. Wouldn't you like dependable information on every little detail of the lineman's work right at your fingertips? This amazing handbook gives you all these facts, and more. Glance over the chapter summary! Could any handbook be more comprehensive?

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I. Elementary Electrical Principles.
II. The Electrical System.
III. Distribution Systems.
IV. Line Materials.
V. Line Equipment.
VI. Line Protective Equipment.
VII. Line Control Equipment.
VIII. Fundamentals of Line Design.
IX. Pole Line Erection.
X. Tower Line Erection.
XI. Inspection Testing and Maintenance.
XII. First Aid.
XIII. Accident Prevention.

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FREE EXAMINATION COUPON

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You may send me Kurtz's THE LINEMAN'S HANDBOOK ($4.00) for 10 days' free examination. I agree to remit for the book or to return it, postpaid, within 10 days of receipt.

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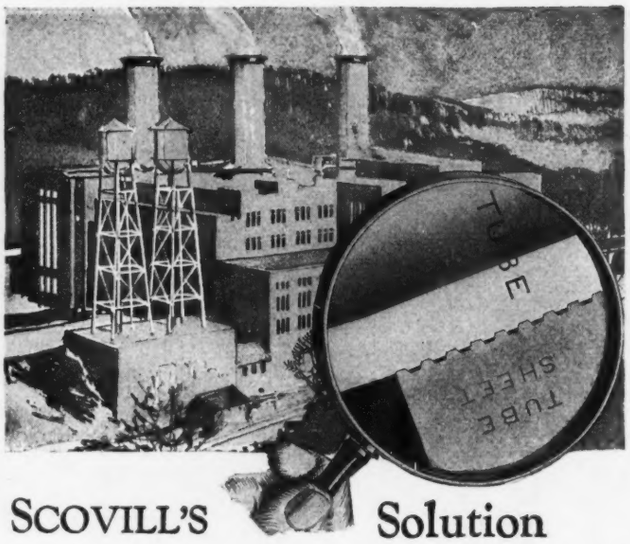


SCOVILL'S Solution To Condenser Tube Problems *Is Proper Installation*

SCOVILL, although the leader in the field, has no monopoly on quality condenser tube manufacture. But Scovill *has* a distinctive method of tube installation, which insures perfect tightness, eliminates fatal changes in metal structure, increases holding power, lessens impingement attack, delays corrosion, diminishes frequency of outages and lengthens tube life.

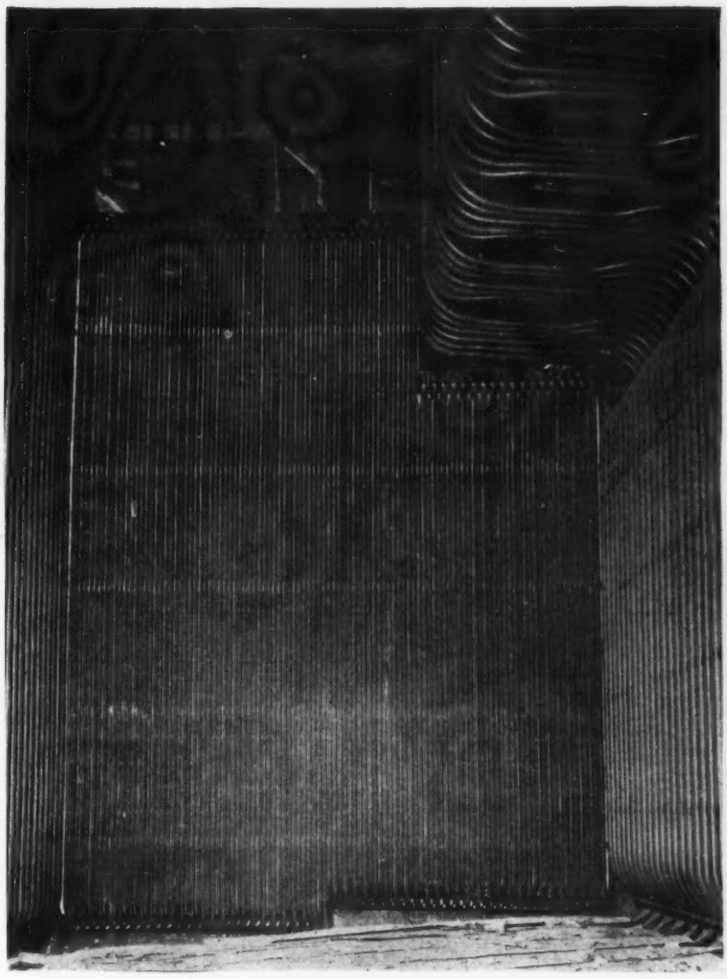
This installation method—the exclusive development of Scovill engineers—banishes one of the power man's chief condenser problems once and for all. It is now available for new installations and replacements in power plants, stationary or marine, and it will save you money.

Confer with an experienced Scovill engineer and consider your condenser with him. If you aren't using Scovill condenser tubes and the Scovill method of installing them, you will be surprised to learn how simple and inexpensive are the remedies and how greatly they will diminish your operating difficulties.

SCOVILL
MANUFACTURING COMPANY
WATERBURY · CONNECTICUT

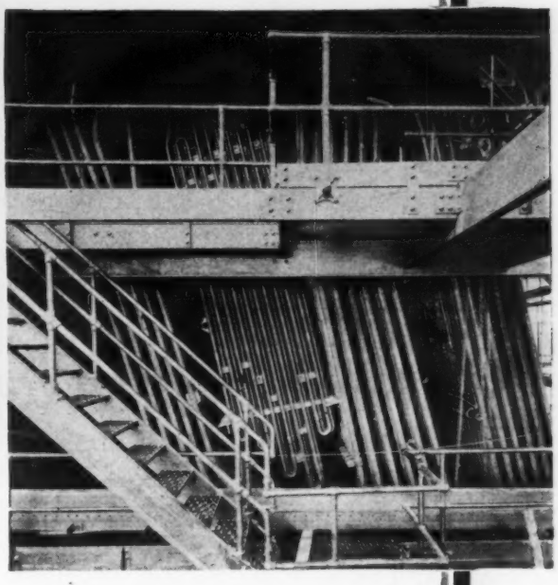
Boston · Providence · New York · Philadelphia
Atlanta · Cleveland · Detroit · Cincinnati
Chicago · Los Angeles · San Francisco · In Europe—The Hague, Holland

ADMIRALTY · SCOVILL · TUBING



Side wall of furnace below 2850 hp. boiler consisting of a Foster Wheeler radiant heat superheater panel 22 ft. wide by 29 ft. high. It superheats half of the steam generated to a final temperature of 750 deg. F.

(Below) View from the side of 1390-lb. pressure boiler. In the center is the Foster Wheeler convection type steam re-superheater, which receives steam from high-pressure turbine at 310 lb. per square inch, and superheats it to a final temperature of 790 deg. F. for use in low-pressure turbines.



1390 Pound Pressure

The superheater equipment for one of four 1390-lb. pressure boilers in the same power plant is here illustrated. The boiler units are each 2850 hp. and are fitted with Foster Wheeler radiant heat high-pressure superheaters and convection type re-superheaters.

These Foster Wheeler radiant superheater elements are of round tube, alloy steel construction. They are light, compact and meet certain operating conditions better than any other design.

Foster Wheeler radiant heat superheaters have been in service for more than three years at this plant and excellent results have been obtained.

FOSTER WHEELER CORPORATION
165 Broadway, New York, N. Y.
Branches in Principal Cities

Foreign Associates—
Foster Wheeler Limited: London, England.
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FOSTER WHEELER

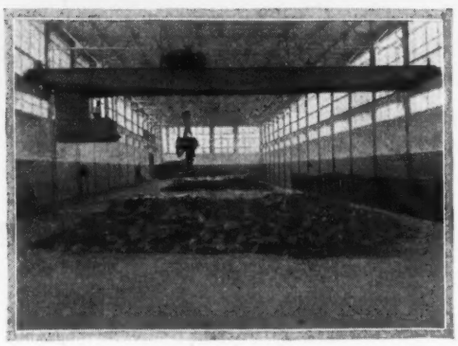
Niles Gantry Cranes

on integral bearings in a bath of oil!

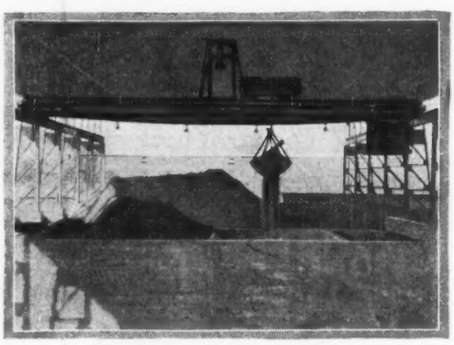
High speed reduction gears are always in perfect alignment in Niles Crane Trolleys. Lubrication is positive. Dust and moisture cannot penetrate. Why? Because of the Niles efficient compact reduction-gear and load-brake design.

And the sturdy simplicity of this unit is typical of every detail throughout all Niles Cranes. That is why speed and accuracy of new crane performance remains a lasting boon to Niles users—and this with a minimum of maintenance expense.

Details of crane bridge and trolley construction are clearly illustrated and described in Niles Bulletins 100 and 101. Write for copies.



Niles Traveling Cranes



Niles Grab Bucket Cranes

SHEPARD NILES CRANE & HOIST CORPORATION
Main Office: 429 Schuyler Ave., Montour Falls, N. Y.
Works: Montour Falls, N. Y., Phila., Pa.

NILES CRANE
DIVISION

THE MOST COMPLETE LINE OF CRANES & HOISTS IN AMERICA

THE PART PLAYED BY I-R CONDENSERS IN CENTRAL STATION PROGRESS

An Ingersoll-Rand single-pass condenser having a total condensing surface of 90,000 square feet serves the 160,000-kw. unit No. 4 in the East River Station of the New York Edison Company. This is the largest single-shell condenser developed to date both in point of surface and condensing capacity. It serves the world's largest single-shaft turbo-generator.

The general condenser design conforms with Ingersoll-Rand standard practice. The shell is heart-shaped in cross-section; the tubes are spaced on graduated stages; external air coolers are used; and provision is made for securing full and complete longitudinal steam distribution.

The tube bank is divided horizontally into three sections. The tubes in any one of the sections can be inspected or cleaned while the remaining two-thirds of the tube bank carries the load.

For a more detailed description of the above unit, write for pamphlet No. 1815

INGERSOLL-RAND COMPANY, 11 BROADWAY, NEW YORK CITY

Ingersoll-Rand

50-SC

The Anaconda Electrolytic Copper used for the manufacture of Condenser Tubes is 99.90% pure and the Anaconda Electrolytic Zinc 99.98% pure.

High Quality *of* ANACONDA CONDENSER TUBES safeguarded by purity of the metals

THE high quality of Anaconda Condenser Tubes is safeguarded by the use of Anaconda Electrolytic Copper and Anaconda Electrolytic Zinc; tin and nickel, when used, are also of maximum purity. This purity of raw materials, plus skillful alloying and the most modern and careful fabrication, accounts for the long life of Anaconda Condenser Tubes.

Standard tubes are finished with a special low temperature anneal to insure uniform grain size and to remove strains or deformation of structure induced in the drawing operations. Every lot is inspected for weight and gauge and tested in accordance with A. S. T. M. requirements whether specified or not.

Anaconda Condenser Tubes are furnished in several alloys, including Admiralty Alloy, 70-30 Brass, Muntz Metal and Ambrac* Metal, a nickel alloy designed for extremely severe service.

Send for Anaconda Publication B-2, Second Edition, an authoritative discussion on Condenser Tubes and Head Plates, with recommended specifications.

*Trade-mark Reg. U. S. Pat. Off.

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn.
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Canadian Mill: Anaconda American Brass Ltd.
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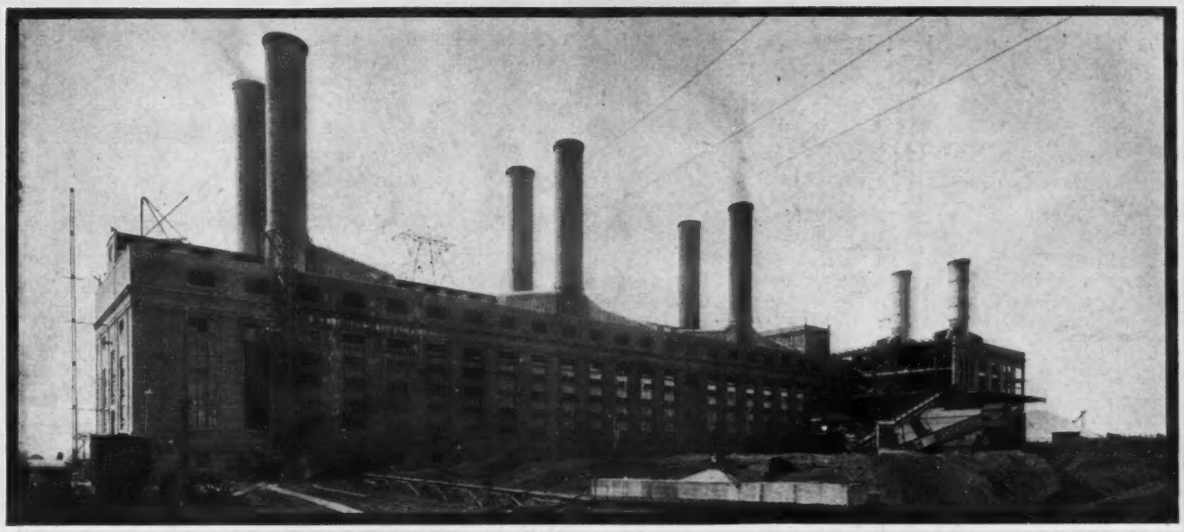
ANACONDA
COPPER ANACONDA BRASS



Connery Construction at Buffalo, Niagara & Eastern Power Corp. Mr. H. C. Cushing, Jr., Chief Engineer

here's the good news!

CONNERY "GOLD METAL" CONSTRUCTION

All joints in Connery Construction are electrically welded.

Maximum expansion and contraction are compensated for at no sacrifice in rigidity.

A minimum number of supports is required.

Non-leaking and non-corrosive.

Individually designed for the plant layout.

In 1926 Connery & Company, Inc., received the gold medal at the Sesqui-Centennial Exposition—for excellence of design and construction of an improved type "expansion-stiffener" construction.

Central stations of all types and sizes now exhibit and prove the basic soundness of leakproof, corrosion-proof, non-sagging Connery Construction.

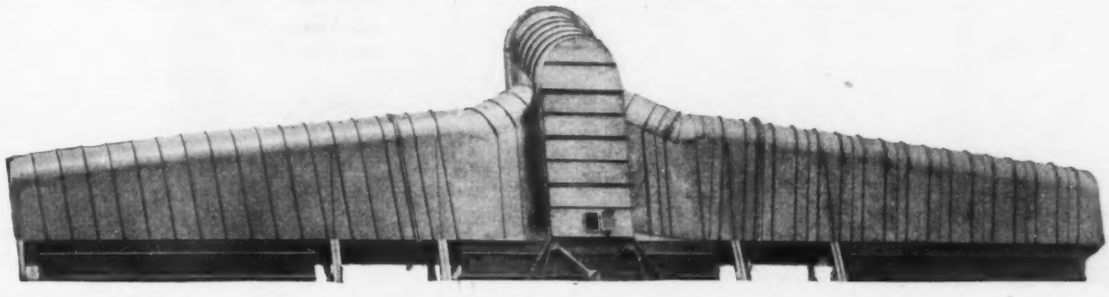
The good news is that you can enjoy the numerous proved advantages of "gold medal" construction at no higher cost.

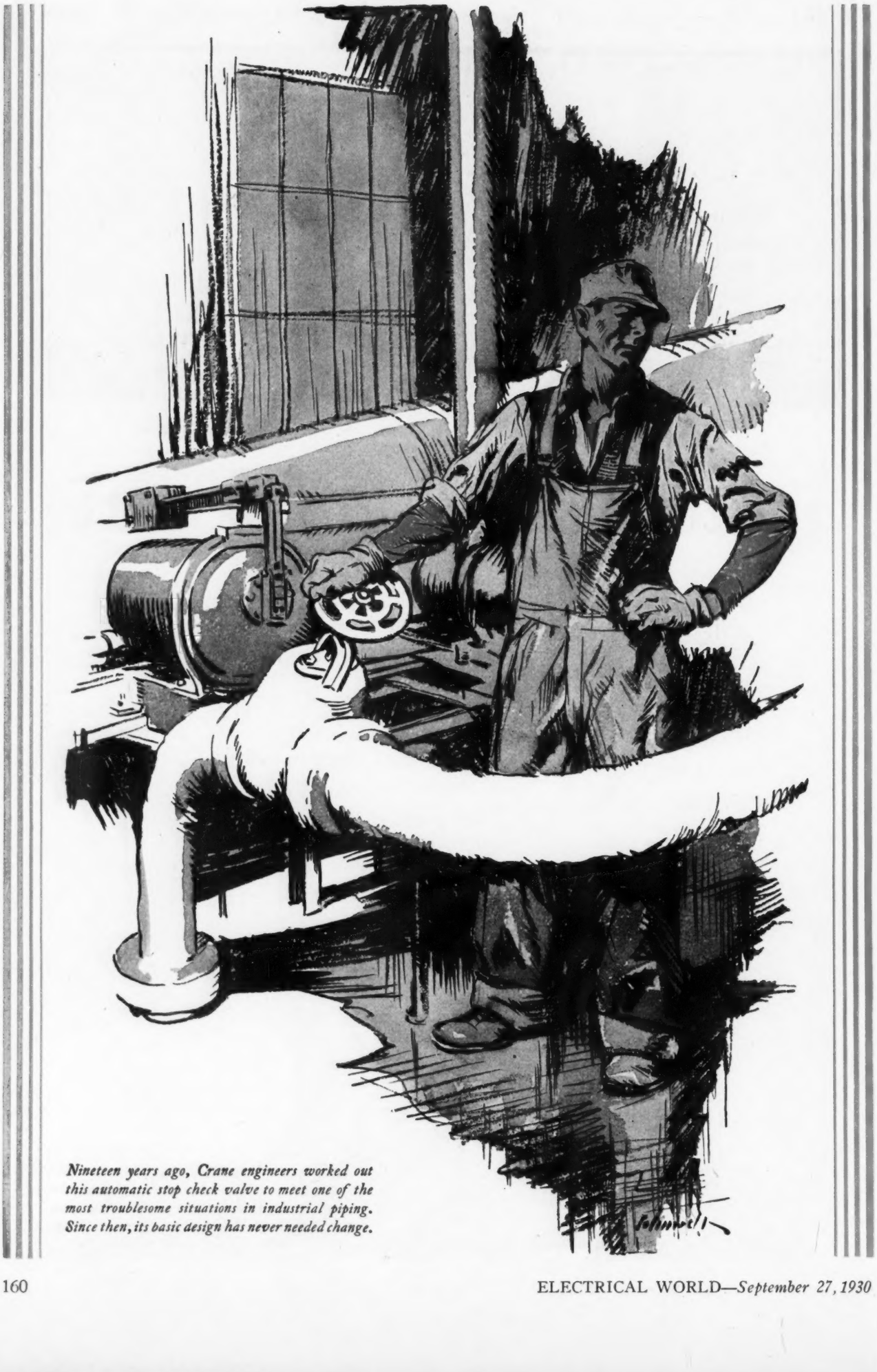
We shall be glad to furnish first class references, quotations and examples.

CONNERY & COMPANY, INC.

Second and Luzerne Sts., Philadelphia, Pa.

Branch Office, New York





Nineteen years ago, Crane engineers worked out this automatic stop check valve to meet one of the most troublesome situations in industrial piping. Since then, its basic design has never needed change.

Audacious simplicity

When George Meredith wrote that "perfect simplicity is audacious," he meant that simplicity, by its very single-minded devotion to its purpose, could often solve difficulties that defy complicated means.

He meant, in brief, exactly what is illustrated in Crane Automatic Stop Check Valves. The job that these valves must do is a big one . . . a failure might cost lives, cause heavy property damage, force expensive shut-downs. To do the job, many highly complicated mechanisms have been devised . . . and proved trouble-breeders.

Yet Crane stop check valves, so extremely simple, stripped down to the vital essentials, with only one moving part . . . the disc . . . and only five parts in all . . . body, liner, disc, yoke, and stem . . . have done that job, and done it perfectly.

Nineteen years ago, Crane engineers evolved the design. Since then, in universal service throughout the country, these valves have stood guard against tube blow-outs, gasket failures in manhole heads, failures around air compressors, when men are at work in a closed-off boiler . . . in a dozen other places. So well have they proved themselves, that throughout these nineteen years, no change in the original basic design has been needed.

No chatter or pound . . . wear sidetracked . . . cleaning and regrinding quick and easy . . . stuffing box repacked under full pressure . . . operation exact, certain, and automatic . . . this example of engineering ingenuity is representative of the quality found throughout the complete Crane line. Our piping engineers, placed at strategic points throughout the country, can tell you about other Crane solutions to all-important piping problems. In selecting materials, in planning a layout, these men are at your service.

1855
SEVENTY-FIFTH
ANNIVERSARY
1930

Even when it is in a line, you can get at any part in a Crane Automatic Stop Check Valve in a jiffy. In reassembling, parts align themselves automatically.

CRANE

PIPING MATERIALS TO CONVEY AND CONTROL STEAM, LIQUIDS, OIL, GAS, CHEMICALS

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO
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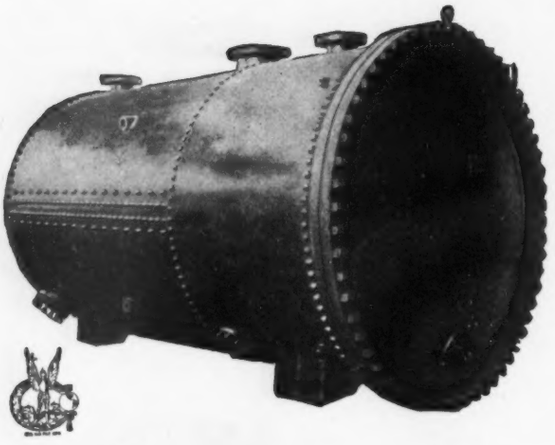
The Evaporator that sheds scale



THE patented curved tubes or helical coiled surface of a G-R Evaporator will readily shed scale when distorted by abrupt temperature changes. This scale-shedding feature of G-R Evaporators makes it possible for central stations and industrial plants to use any convenient source of raw water supply to produce distilled water for boiler feed make-up, thus eliminating costly and excessive boiler blow-down.

Over 10,000,000 hp. of boilers are now equipped with G-R Evaporators, the average installation repaying its cost every two years or less through fuel savings alone.

The Griscom-Russell Company
285 Madison Avenue, New York
Branches in principal cities

Griscom-Russell
Heat Transfer Apparatus

WHEN governor problems arise our comprehensive experience will be of value to you. "Write for Catalogue M."

WOODWARD GOVERNOR CO., Rockford, Ill.

WOODWARD
WATER WHEEL
GOVERNORS

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1 OF 21

Sizes and Types of Hand and Motor Operated Cold Pipe Bending Machines we make bending ⅛ to 8-in. Pipe.

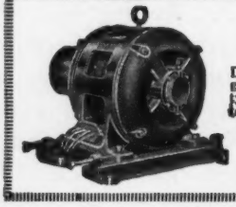
Cost of Bending

1-in.—3 cents	3-in.—20 cents	6-in.—60 cents
2-in.—5 cents	4-in.—40 cents	8-in.—$1.00

Over 8,000 in use. Send for Catalogue.

Pipe Threading and Cutting Machines ⅛-in. to 16-in.

American Pipe Bending Machine Co.
28 PEARL STREET, BOSTON, MASS.



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GOVERNORS

Powerful, quick-acting oil-pressure governors in sizes and types for any application or special condition. For many years, the name LOMBARD has stood for *reliable service* and *closest regulation obtainable.*

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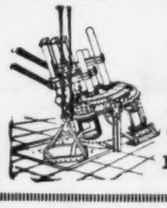

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Ten Standard Sizes ½ to 24 Tons Capacity
Most Rapid and efficient for making
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D. C. and A. C.. Ball Bearing Motors of the medium commercial sizes. D. C. machines up to 75 HP. with Commutating Poles. Get Bulletin No. 200.

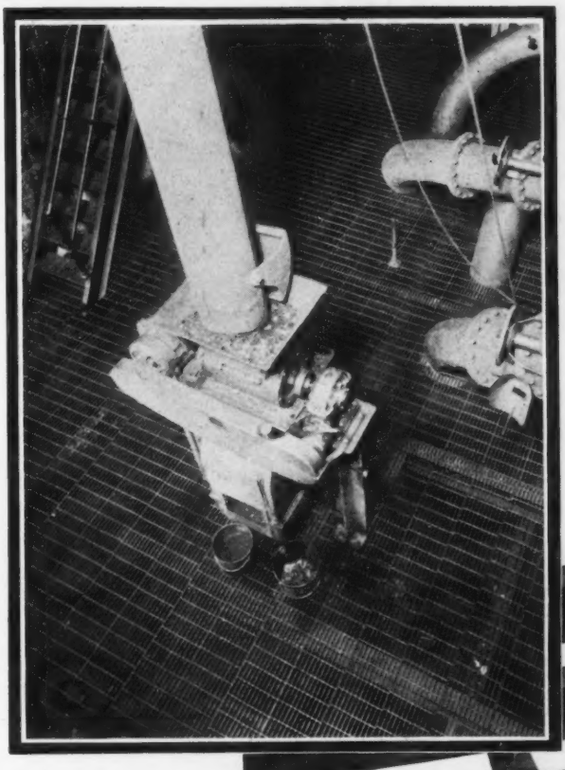
A. C. Machines up to 75 HP. All standard speeds and voltages. Get Bulletin No. 300.

Special machines built to meet your needs. Full details cheerfully supplied. Write.

Marble-Card Electric Company
Gladstone, Mich.

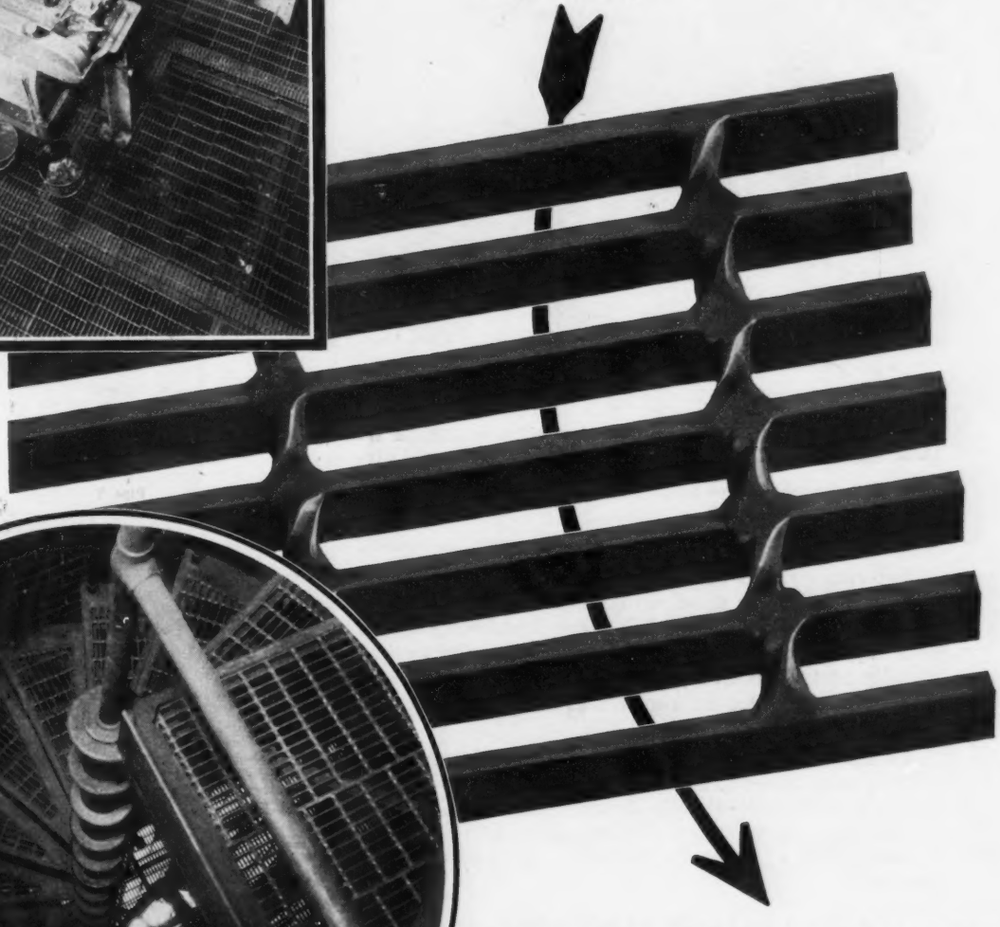
BLAW-KNOX *Electroforged* GRATING

An open flooring conforming to modern engineering practice



For stairways, circular or straight, for runways or large areas where an open flooring is desirable, Electroforged grating provides the ultimate in every quality—strength—open area for light and air—non slip surface—self cleaning—lowest maintenance. One piece construction—no bolts, slots or rivets—no rattles. The views shown are from the modern plant of the Union Electric Light & Power Company, Venice, Ill. Ask for sample of grating and catalog without obligation.

Mail the Coupon



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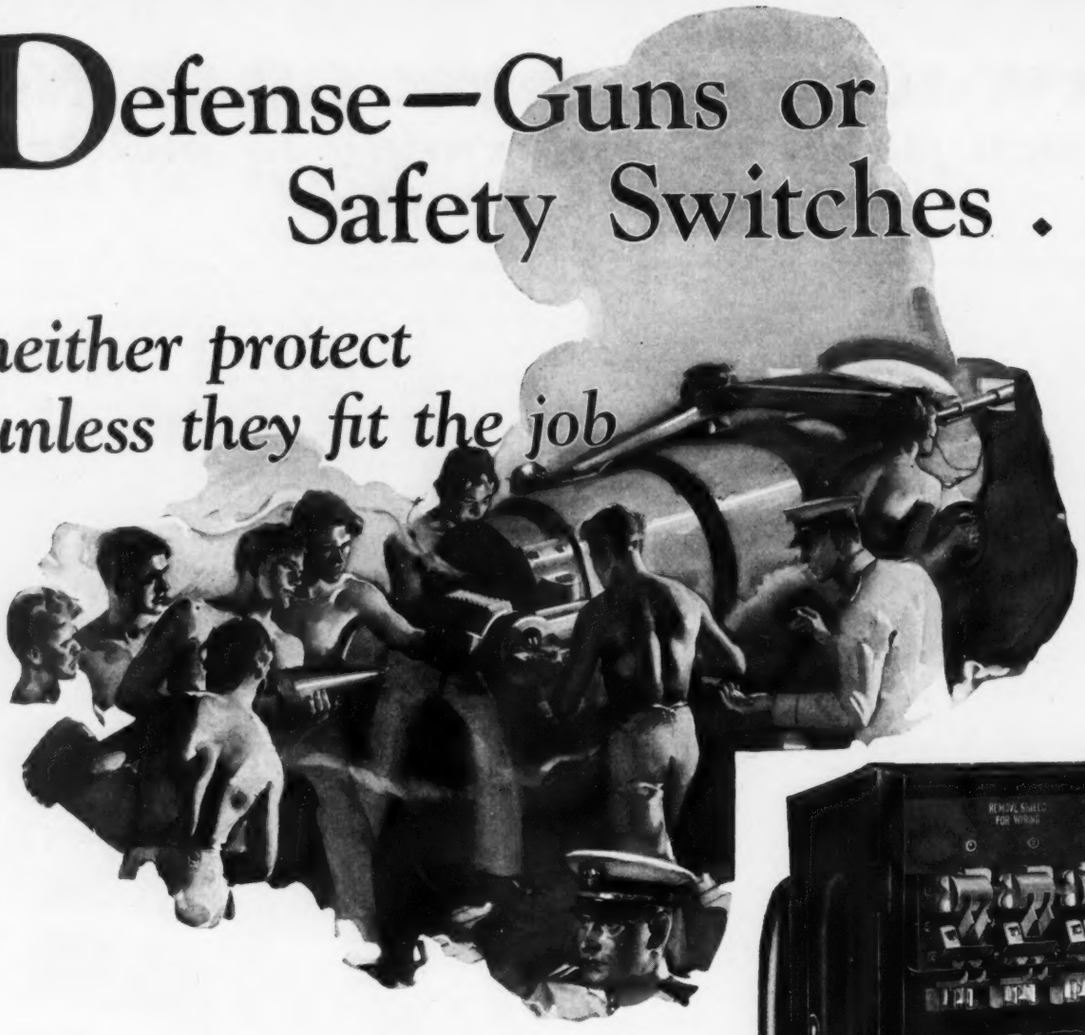
CITY ..... STATE .....

Defense—Guns or Safety Switches . . .

neither protect unless they fit the job



HEAVY guns effective against enemy warships would be almost useless against enemy planes . . . and vice versa.

So it is with safety switches. The different types of safety switches have specific purposes, and to give protection, they must fit the installation for which they are intended.

For heavy, mill-duty, select a safety switch with ample capacity for every need, with ample reserve for any emergency, the Cutler-Hammer "Current Breaker", Bulletin 4101. It is rated for a.c. or d.c. up to 600 volts and guaranteed to handle 300% overloads. In test, it has interrupted a 600% overload 21 times in rapid succession without breaking down.

14 features, offering advantages which no other safety switch can muster, make this switch the only one of its kind. It is described fully in the C-H *Safety Switch Catalog* which also shows the C-H Industrial Duty "Type A" and Standard Duty "Type C" Switches. A copy will be sent on request.

CUTLER-HAMMER, Inc.

Pioneer Manufacturers of Electric Control Apparatus

1313 St. Paul Avenue MILWAUKEE, WISCONSIN

The C-H "Current Breaker" Bul. 4101-H14—3 pole —230 V.—60 Amp.

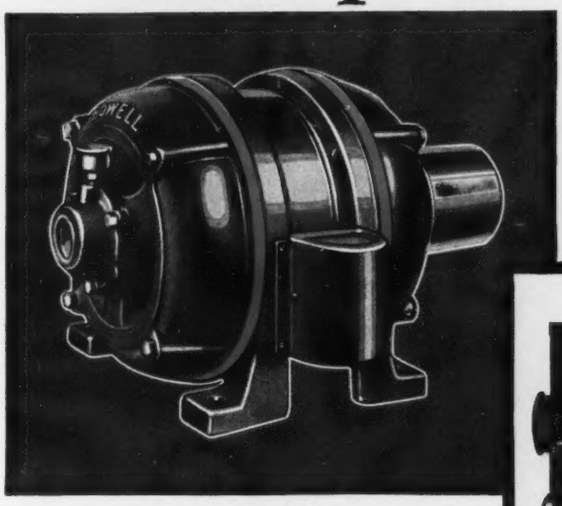
Enclosed view —Bul. 4101-H15—3 pole —230 V.—100 Amp.

CUTLER HAMMER

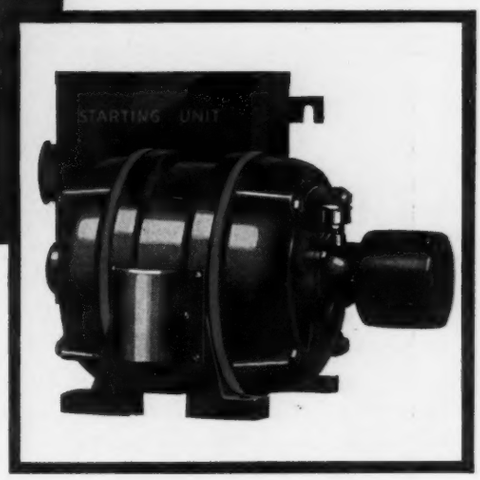
High Quality Safety Switches For Every Service

(A-367)

for Multi-speed Applications *give* RED BANDS *your hard jobs*



Above — Multi-Speed Polyphase motor; 2-3-4 speeds, 2 or 3 phase, ordinary or consequent pole models.



Right — Brush-Less Single Phase Multi-Speed motor: two-speed, separate winding, model only.

Howell Red Band Multi-Speed Polyphase and Brush-Less Single Phase motors are built in all standard combinations of speeds, power, voltages and frequencies in the following three ratings:

1. **Constant horsepower, variable torque.**
2. **Constant torque, variable horsepower.**
3. **Variable horsepower, variable torque.**

The Brush-Less Single Phase motor (built like a standard squirrel cage polyphase motor without brushes or commutator) is offered in two-speed, separate winding, models only. Starting may be accomplished at either speed with a drum or other control equivalent to a three-pole, double-throw switch.

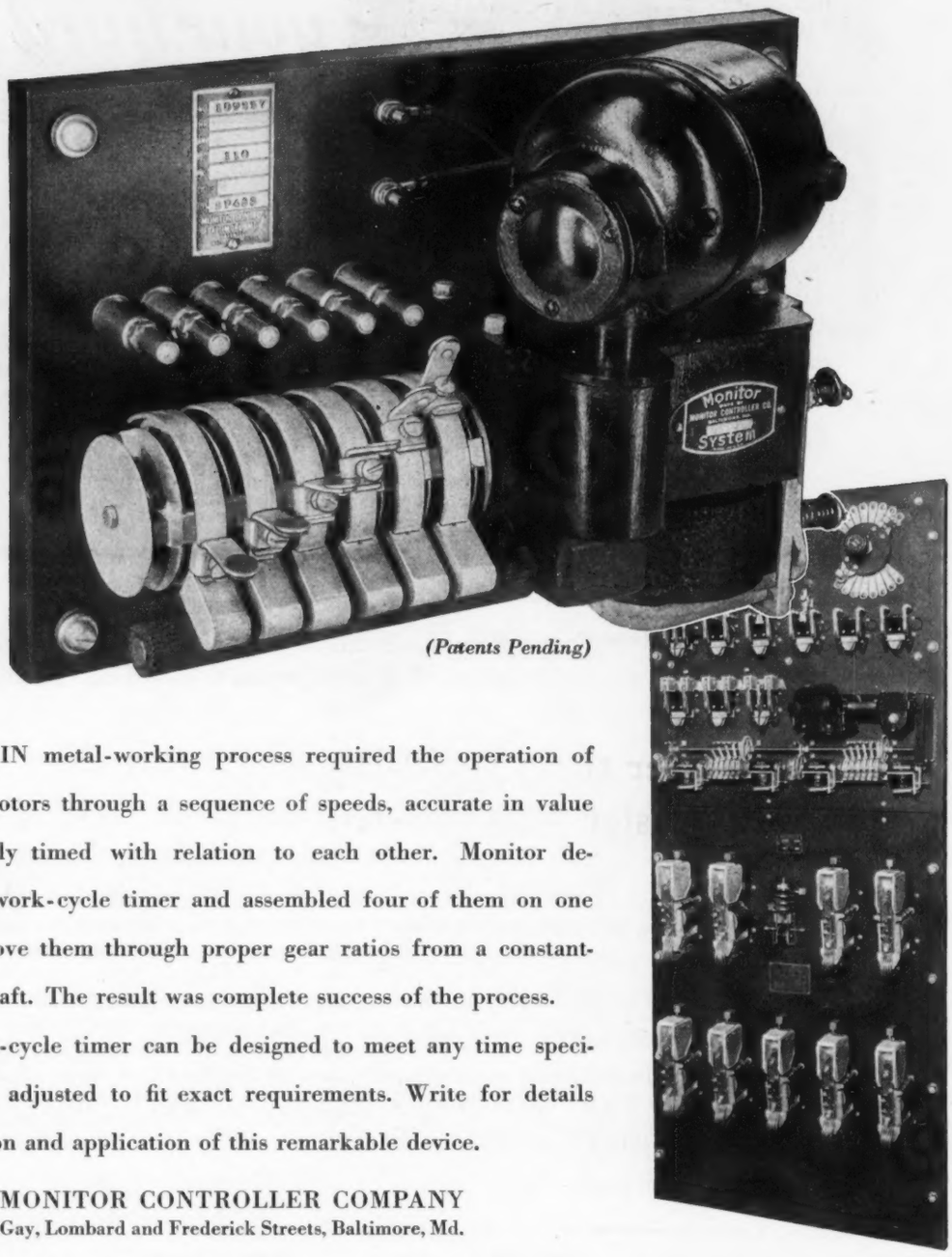
The polyphase model is obtainable in two, three or four speeds in ordinary pole or consequent pole types, with push button or drum control.

For further information consult your nearest Howell engineer or write direct to the HOWELL ELECTRIC MOTORS COMPANY, HOWELL, MICH. *Sales and service in more than 50 principal cities.*

Howell RED BAND ELECTRIC Motors

MAKE GOOD ON THE HARD JOBS

A *Story of Success . . .*
Monitor did its share



(Patents Pending)

A CERTAIN metal-working process required the operation of its driving motors through a sequence of speeds, accurate in value and accurately timed with relation to each other. Monitor developed the work-cycle timer and assembled four of them on one panel and drove them through proper gear ratios from a constant-speed jack shaft. The result was complete success of the process.

The work-cycle timer can be designed to meet any time specifications and adjusted to fit exact requirements. Write for details of construction and application of this remarkable device.

MONITOR CONTROLLER COMPANY
Gay, Lombard and Frederick Streets, Baltimore, Md.

IF YOU HAVE A CONTROL PROBLEM . . . CONSULT MONITOR

Monitor *does it automatically*

82-6532-10

Consider the "Weld-Built" Motor for your "design and construction" program

It has been designed to meet the demands of present day industry, and can be depended upon to give unfailing service at a minimum cost for operation and maintenance.

Back of this thoroughly modern machine stands 50 years' experience in building motors and generators of recognized quality and dependability.

The most modern methods of electric welding and mechanical construction have been employed in its manufacture. It is light and strong, contains no cast parts, and is highly efficient.

The field-frame is rolled from forged steel, insuring uniformity of magnetic circuit. The massive feet are welded to the frame. Armature can be easily removed from motor. Shaft can be removed without disturbing windings and commutator connection. Coils are wound in skewed slots insuring minimum noise. The main poles are built of laminations held together by welding.

These are but a few interesting details of construction. Send for Bulletin No. 262 and you will readily understand why we insist that there is no motor in its class better suited to the exacting requirements of industry today.

Electro Dynamic Company

Bayonne *Established 1880* New Jersey

Manufacturers of Alternating Current Motors and Direct Current Motors and Generators

"Quality for Half a Century"

USKA BUKET

The Balearic Islanders take their love affairs seriously.

It is the custom of eligible maidens to apportion an evening into several periods and allow a certain number of minutes in which each suitor may press his cause.

If one overstays his time—he must answer to the next for uska buket, or stealing the next suitor's time, and the result is usually a nice knifey scrap.

The one point in this custom that is praiseworthy is the fact that she plays no favorites until, through comparison, the favorite is discovered—somewhat after the method of carbon brush buyers.

And let us state that we prefer Morganite brushes be adopted in this manner after a tryout of all comers, for then the buyer realizes his gain in Morganite.

Of course there are some developments in Morganite such as the EG-12 for rotary converters and heavy-duty generators where this procedure cannot be followed since it takes two to make a comparison.

Morganite Brush Co., Inc.

Main Office and Factory

3302-3320 Anable Ave., Long Island City, N. Y.

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Cleveland, Electrical Engineering & Mfg. Co., 320 Union Building
Birmingham, Ala., A. J. Bowron, 1210 Watts Building
Revere, Mass., J. P. Drummey, 62 Pleasant Street
Los Angeles, Electrical Engineering Sales Co., 502 Delta Bldg.
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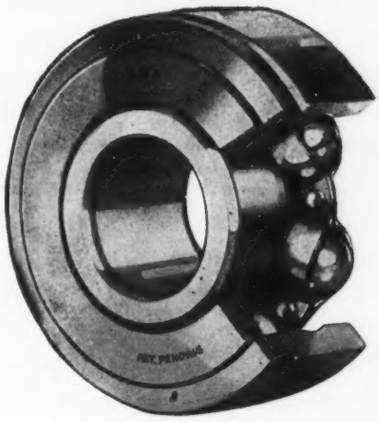
Simplify- and Save!

With this new . . . . .

PRECISION BEARING



ELIMINATES closure caps — cuts out machining of outer housing face—does away with drilling, tapping and machine screws — reduces machining operations — speeds up assembly — cuts mounting costs.

Self-contained — felt-sealed — dust-and-dirt-proof — grease-packed, with a larger grease capacity—all-steel, with a one-piece outer ring.

Write for the "Greaseal" Data Sheets.

"GREASEAL"

FELT-PROTECTED

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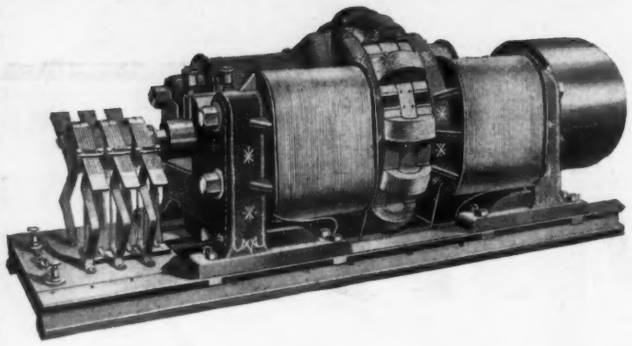
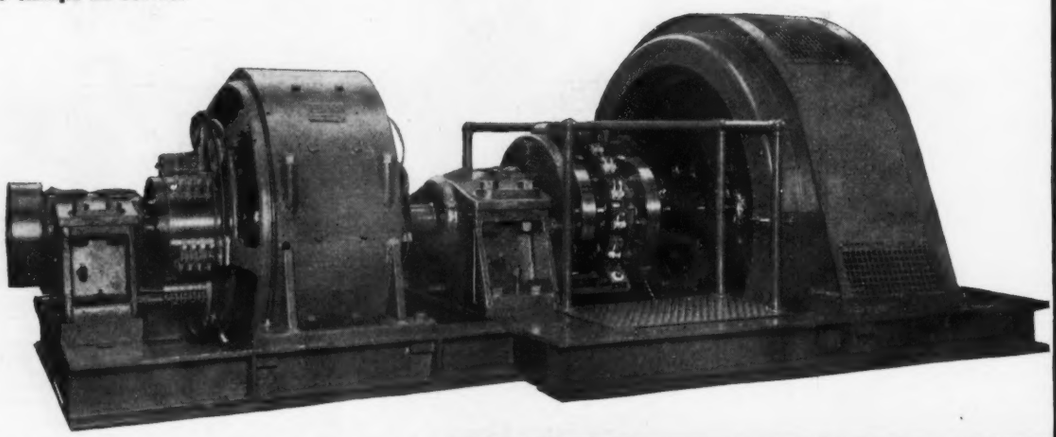
NORMA-HOFFMANN BEARINGS CORPORATION STAMFORD, CONN., U.S.A.

better brushes GREATER POWER



Early type of Brush Arc Dynamo designed for operation of arc lamps in series.



...MODERN KRAMER MOTOR SET

THE BIRTH of the carbon-arc lamp marked the beginning of electricity's rapid advance in industry—an advance in which the products of National Carbon Company, Inc., played a very important role. With the coming of the carbon-arc lamp, street lamp-lighters went out of business and the era of mechanically generated electric power began.

The Brush Arc Dynamo, illustrated at the left, is typical of the first generating units used when electric street-illumination was in its infancy. Constant current was maintained by the automatic regulator which adjusted voltage to the number of lamps in operation on the series circuit. Street-lighting at that time was the entire load of power-plants.

What a change there has been since the days of the Brush Arc Dynamo! Yes, street-lighting has made tremendous progress. However, it now represents less than two per cent of the total amount of electricity used. Two-thirds of the total 1929 consumption, in fact, was applied to turn the wheels of industry.

Witness, therefore, giant machinery able to carry huge loads, like the Kramer Motor Set shown at the right. Delivering a constant horse-power output at adjustable speed with variable voltage and frequency impressed upon the commutating elements. It presents a difficult commutation problem — one which would have been too much for the commutator-brushes of only a few years back, not to mention those of the Brush Arc Dynamo days.

National Carbon Company, Inc., with its years of leadership in brush manufacture, offers a National Pyramid Brush to meet the needs of many difficult problems of brush application in modern industry.

NATIONAL CARBON COMPANY, INC.

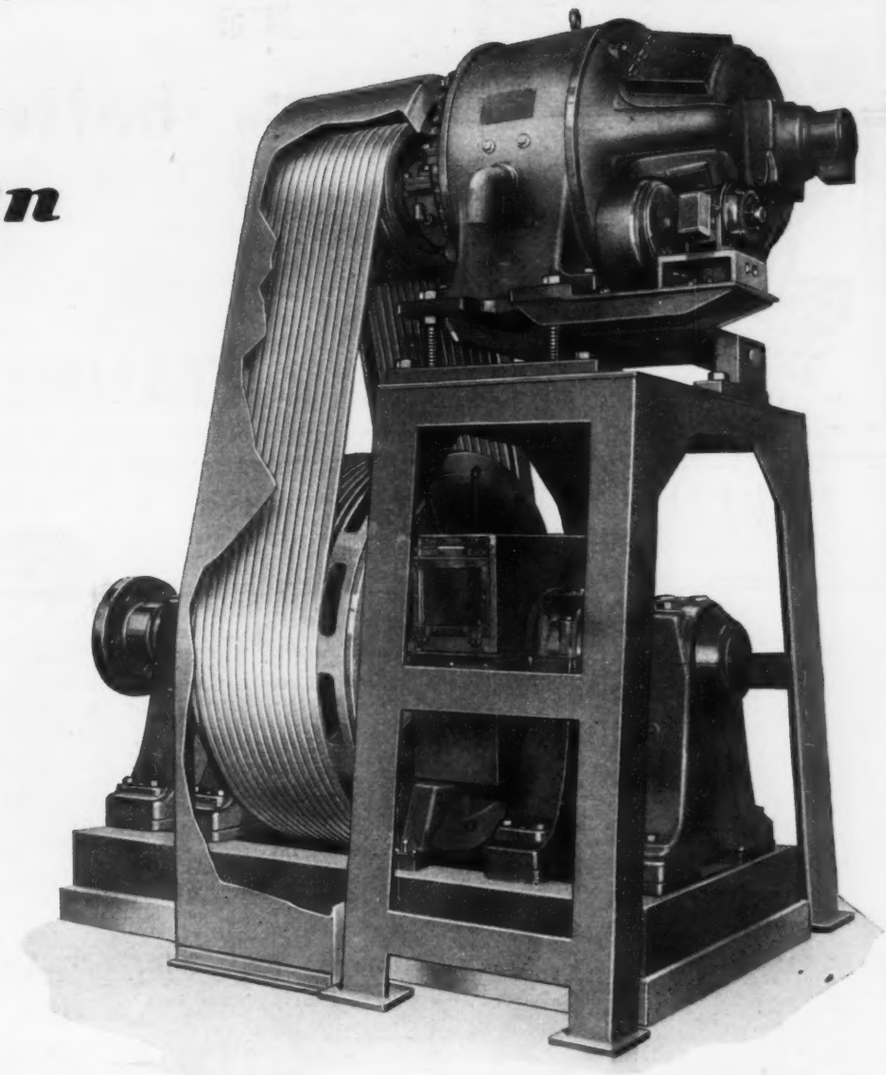
Unit of Union Carbide UCC *and Carbon Corporation*

Carbon Sales Division SILVER STRAND CABLE TRADE MARK REGISTERED Cleveland, Ohio

Branch Offices and Factories

New York Pittsburgh Chicago Birmingham San Francisco

Rossman System



Adjustable Speed Control

with High Efficiency

—for alternating current drives

Rossman drives are used for variable torque work such as induced or forced draft fans, centrifugal boiler feed pumps, condenser pumps, etc., and for constant torque work such as coal crushers, plunger pumps, etc.

Allis-Chalmers Rossman drives for operating forced and induced draft fans at the station of the Super Power Company of Illinois, Powerton, Illinois, have a speed range of 2½ to 1 with speed adjustments made in such small increments that the effect is substantially a smooth speed curve throughout the entire range of the control, irrespective of changes in the load.

No power is dissipated in resistance units for low speed operation. Speed variation is obtained by rotating the stator or primary member of an induction motor either backwards or forwards.

Higher efficiency is obtainable with this system than from slip ring induction motors with external resistance, two-speed induction motors, or the Ward Leonard System of speed control.

The Rossman System is simple, reliable, and efficient, with no complicated machines or connections.

Write for details.

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MILWAUKEE, WIS. U.S.A.

M-R INSULATION MFG CO

Everything In Insulation

Compounds, Waxes & Paints
Varnishes and Varnished Materials
Insulating, Waterproofing & Maintenance Paints

MITCHELL-RAND MFG. CO., 17 Vesey St., N. Y.

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show gate positions and valve movements as well as water elevations.
TANNER REMOTE INSTRUMENTS eliminate hand gauging and human errors in readings.
TANNER INSTRUMENTS give continuous records, accurate and reliable.
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ALPHABETICAL INDEX TO ADVERTISERS

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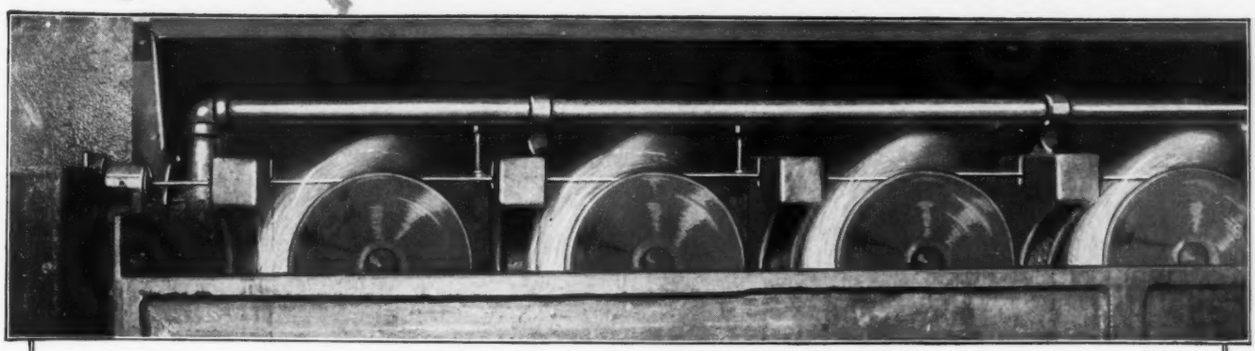

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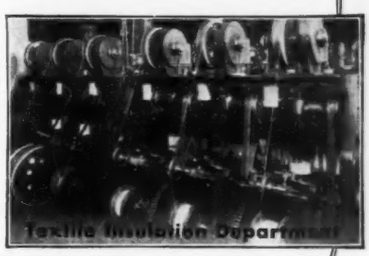

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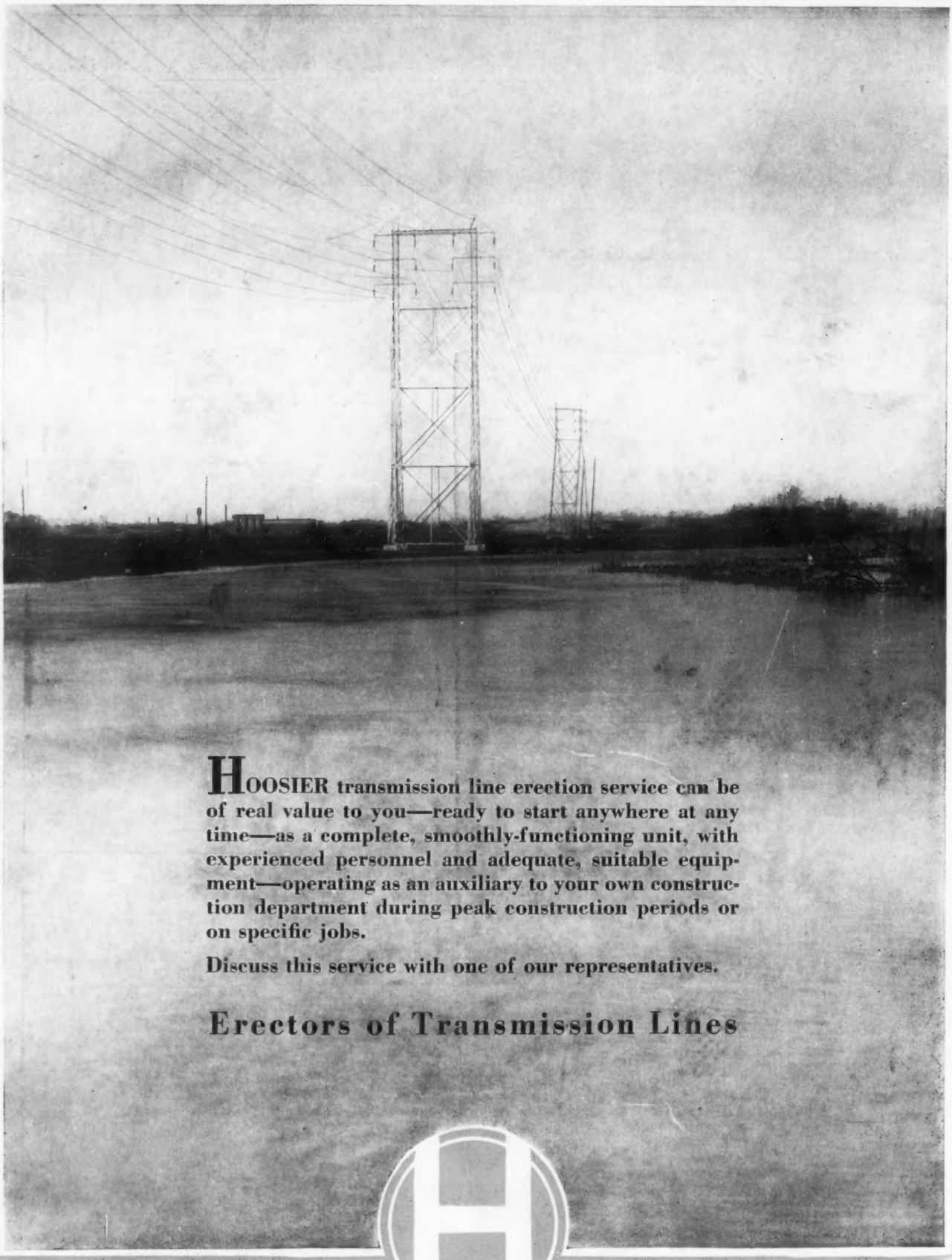

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